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# Commercial Motor Vehicle Speed Control Devices

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16. Abstract

This report reviews the problem of heavy vehicle speeding (in particular, speeding at greater than 65 mph) and speeding-related crash involvements. The report describes and assesses devices available to control truck speed, and addresses the question of whether the use of speed control devices by heavy trucks should be mandated. The report finds that, by all measures of crash involvement, speeding is not a significant factor in the crash picture of *single-unit* trucks. Thus, most of the report addresses *combination-unit* trucks, which present a more complex picture.

Non-detectable radar studies show that highway speed limit compliance by combination-unit trucks is poor, but better than that of passenger vehicles. Most trucks that speed travel at just over the posted speed limit. Crash statistics indicate that speeding is generally less involved in combination-unit truck crashes than it is in passenger vehicle crashes. The report describes devices available to control truck speed, and ways that they are applied in commercial fleet settings. The report is supportive of fleet applications of speed-monitoring and speed-limiting devices, but concludes that there is not sufficient justification to consider requiring all heavy trucks to be so equipped. Problem size statistics suggest that the number of target crashes is low, e.g., approximately 30 fatal crash involvements per year for combination-unit trucks. This small crash problem size, together with uncertainties regarding the potential for crash reduction, suggest that the benefits of mandatory speed limitation are questionable.



17. Key Words combination-unit trucks; speeding; high speed crashes; speed-limiting devices; road speed governors; speed-monitoring devices

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**COMMERCIAL MOTOR VEHICLE SPEED CONTROL DEVICES**

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# EXECUTIVE SUMMARY

Heavy truck safety has improved dramatically over the past decade. The fatal crash involvement rate for medium/heavy trucks was 3.7 per 100 million vehicle miles of travel in 1988, an all-time low. Between 1977 and 1988, the fatal crash involvement rate for combination-unit trucks decreased 40 percent, while the rate for passenger vehicles (cars/light trucks and vans) decreased only 25 percent. The efforts of motor carriers and their drivers, coupled with expanded state-Federal programs to license commercial drivers and inspect vehicles at roadside, all seem to be having a positive effect.

Despite these encouraging findings and the efforts of most motor carriers and drivers to operate responsibly, many motorists are uncomfortable sharing the highways with heavy trucks. These concerns are heightened when trucks speed, principally because of the relative size of trucks compared to passenger vehicles. Because of the size of trucks, truck crashes in general have a greater likelihood of causing a fatality than do passenger vehicle crashes. As could be expected, the preponderance of these fatalities occur among occupants of the other, generally much smaller, involved vehicles, rather than among truck occupants.

In response to these concerns, it has been suggested that trucks should be required to be equipped with devices to control their maximum speed. This study examines the safety issue of truck speeding and considers the merits of mandating the installation of speed control devices on heavy trucks. Two principal forms of speed control are addressed: (1) speed-limiting devices ("governors"), which directly limit engine and/or road speed; and (2) speed-monitoring devices, which do not control vehicle speed directly, but rather provide a continuous record of vehicle speed that may be used to determine if speeding has occurred.

In most states the speed limit for heavy trucks on rural Interstate highways is 65 mph. Heavy trucks, notably combination-unit trucks, which are the focus of most of the concern, accumulate much of their travel mileage on rural Interstate highways. Thus, if speed-***limiting*** devices were required on heavy trucks, they would have to be designed to allow travel speeds of at least 65 mph in order to permit trucks to travel at speeds up to the legal maximum. In this report, 70 mph is used as a hypothetical value at which speed-limiters might be set. A speed-limiter setting near 70 mph would permit trucks to travel at the speed limit on 65 mph roadways, with some added tolerance for additional power needed for hill-climbing or passing. Data are also provided relating to crashes occurring at speeds greater than 65 mph.

This report notes the fact that most heavy truck crashes do not occur on roadways where very high travel speeds (e.g., greater than 70 mph) are prevalent. More than 90 percent of combination-unit truck crashes and 95 percent of single-unit truck crashes occur on roadways where the speed limit is less than 65 mph, and where the incidence of truck speeding in excess of 70 mph or even 65 mph is low. Speed-limiting devices would have no effect on vehicle speed or crash likelihood at travel speeds below their set point (e.g., 70 mph).

Moreover, speed-limiters would not control speeding on downgrades that are steep enough for the vehicle to be in a free roll. In a free roll situation, vehicle speed is not determined by engine revolutions or gearing but rather by the force of gravity acting against the rolling resistance of the vehicle. Because of the desire to maximize fuel economy, the rolling resistance of today's trucks is minimal, in particular when considered in relation to their weights. Since high truck speeds on downgrades would not ordinarily be affected by speed-limiting devices, this report excludes on-grade crashes from the all target crash problem size assessments of crashes involving speeds greater than 65 mph.

The use of ***speed-monitoring*** devices--devices which provide a continuous record of vehicle speed during a trip--may be applicable to a broader range of highway travel (i.e., 55 mph and 65 mph highways), assuming that the individual monitoring the vehicle speed data knows the posted speed limit for the highway traveled. In consideration of this broader applicability of speed-monitoring devices, this report addresses truck speeding ***in general*** as well as speeding in excess of the potential maximum speeds at which mandatory speed-limiting devices might be set (e.g., 70 mph).

For all vehicle types, driver compliance with posted highway speed limits is poor. However, when trucks do speed, it is typically at levels just over the speed limit. The extent of truck speeding in excess of 70 mph varies with the posted speed limit. On highways posted at 55 mph, about 3 percent of trucks speed in excess of 70 mph. On roads posted at 65 mph, about 14 percent of trucks exceed 70 mph. By comparison, about 10 percent of all passenger vehicles (cars and light trucks) exceed 70 mph on 55 mph highways, while about 23 percent exceed 70 mph on roads posted at 65 mph.

Although commercial vehicle drivers are often under economic pressure to move goods quickly and thus possibly to speed, there are also significant economic incentives not to speed. Fuel usage and engine maintenance requirements are considerably less when speeds of less than 65 mph are maintained. Multiple speeding citations for offenders can lead to commercial driver's license suspension--an economic catastrophe for most drivers. Moreover, a cooperative Federal-state program, the Commercial Driver's License (CDL) Program, now exists to prevent drivers from obtaining multiple licenses and/or accumulating multiple speeding convictions in different states with impunity.

Police accident report data suggest that comparatively few heavy truck crashes involve truck travel speeds in excess of 70 mph. Only about 0.2 percent of all combination-unit truck crash involvements, and 0.7 percent of fatal crash involvements, occur at police-reported estimated travel speeds in excess of 70 mph. By comparison, about 0.5 percent of all passenger vehicle crash involvements, and about 6 percent of fatal crash involvements, occur at estimated speeds in excess of 70 mph. In 1988-89, there was an average of approximately 30 combination-unit truck fatal crash involvements where a vehicle travel speed in excess of 70 mph was noted by the investigating police officer. In comparison, there were an average total of 4,063 combination-unit truck fatal crash involvements at all travel speeds. There were 3,614 involvements of all vehicle types (mostly passenger vehicles, but including trucks) in fatal crashes where the vehicle was traveling at speeds greater than 70 mph. Thus, high-speed truck crashes represent a small proportion of both the overall truck crash picture (0.7 percent) and the overall high-speed crash problem (0.8 percent).

Involvement ***rates*** in speeding-related crashes are also relatively low for combination-unit trucks. For example, the combination-unit truck involvement rate for all crashes with police-reported speeds of greater than 70 mph was on the order of 0.3 per 100 million vehicle miles traveled (VMT) in 1988-89. The comparable statistic for passenger vehicles was approximately 2.4 per 100 million VMT. For fatal crash involvements, the estimated rates were 0.03 per 100 million VMT for combination-unit trucks and 0.19 for passenger vehicles.

Another statistical approach to assessing the role of speeding and speeding in excess of 65 mph in heavy truck crashes is to derive the average number of relevant crash involvements per 1,000 vehicles. This is, in essence, a measure of the annual ***likelihood*** that a vehicle will be involved in a relevant crash. Annually, approximately 0.18 combination unit trucks per 1,000 registered are involved in a crash at a police-reported travel speed of greater than 70 mph, whereas the comparable figure for passenger vehicles is 0.25. The “likelihood” statistics are more similar for trucks and passenger vehicles than are the "rate" statistics. This is due to the greater exposure of combination-unit trucks to crash risk; on average, these vehicles travel six times as many miles per year per vehicle than do passenger vehicles, and 10-15 times more miles on 65 mph highways.

The speeding-related crash picture for ***single-unit*** trucks is very different from that of either combination-unit trucks or passenger vehicles. By ***all*** statistical measures, the numbers of crashes involving single-unit trucks exceeding the posted limit, speeding in excess of 65 mph, or speeding at higher speeds are low. For example, the annual probability that a single-unit truck will be involved in a crash involving a police-reported speed in excess of 70 mph is on the order of 1 in 33,000 (i.e., 0.03 involvements per 1,000 vehicles).

An important caveat relating to all speeding-related crash statistics cited in this report is that the categorization “speeding-related” or “high-speed related” does not necessarily assure that speeding was the ***primary cause*** of the crash or any resulting fatalities. Virtually all crashes involve multiple contributing factors. The elimination of any one factor--e.g., high speed--may or may not prevent the crash. Thus, the speeding-related and high-speed-related crashes identified in this report should actually be viewed as ***potential*** target crashes for speed control devices. Although speed control devices (if not tampered with) are likely to reduce the highway speeds of those trucks that do speed, their effectiveness in preventing and/or reducing the severity of these potential target crashes is unknown.

Speed-limiting devices include mechanical engine speed governors, cruise controls, road speed governors, and electronically-controlled engines with transmission/rear axle/tire ratios designed to physically limit vehicle speed. All these approaches have limitations. First, as noted, none of these devices can effectively control downhill vehicle speeds. Truck speeding-related crashes involving downgrades, where the vehicle was in a free-roll, would be unaffected by speed-limiting devices. Mechanical engine speed governors limit the engine's maximum speed, but do not limit the vehicle's top speed unless the engine is matched with a transmission and rear axle geared to also limit top speed. Even then, conventional engine speed governors allow the engine to "overshoot" and thus attain higher than rated vehicle speeds. Cruise controls must be activated by drivers and, therefore, can be set at speeds higher than 65 mph or simply not be activated. Road speed governors, devices that monitor and control actual vehicle speed, can effectively limit truck speed. However, most designs are only tamper-resistant; none are tamper-proof. A determined truck driver or truck owner can defeat these devices.

The Environmental Protection Agency's heavy duty engine emission control regulations require more stringent emissions standards in the 1991 model year, with further emissions reductions required beginning with the 1994 model year. New truck diesel engines developed to meet the 1991 standards, and under development to meet the 1994 standards, include electronic controls on engine speed. These electronic controls are intended primarily to ensure that emissions standards are met, but they have the ancillary benefits of improving fuel economy and providing a means of limiting maximum vehicle speed. Thus, a speed-limiting capability is already being built into new heavy duty vehicle engines. This road speed limitation is accomplished by reducing engine RPMs as road speeds approach the governed limit. In order to maximize fuel economy and meet EPA's emissions standards, most buyers specify engine/drivetrain gearing combinations with optimal cruising speed ranges of 55-65 mph. Optimal specifications for a given buyer are dependent on such factors as type and size of loads carried, predominant roadway types traveled, and desired fuel economy. Market penetration of the new engines will increase by approximately 7-10 percent annually until fleet turnover is virtually complete in the early 2000s.

Speed monitoring/recording can be accomplished with a variety of electronic and mechanical devices and can be an effective tool for fleet managers in their efforts to responsibly control the operation of their vehicles. Equipping a truck with a speed recorder does not guarantee, however, that it will be operated within speed limits. Active management involvement in monitoring and following up on data provided by speed recorders is critical to their effectiveness. Moreover, the incremental benefits of installing speed-monitoring equipment may be questionable for those fleets where management practices are already in place to minimize speeding. In spite of these limitations, many fleets currently use speed monitors and are generally satisfied that they are worthwhile. However, no systematic fleet test data were identified to document the actual effectiveness of such devices in reducing crash involvement.

A speed-monitoring system that includes external electronic ports whereby enforcement officials could obtain direct roadside access to truck trip speed data is technically feasible. However, such a system would require elaborate system specifications, industry-wide standardization, and substantial equipment investments by both motor carriers and enforcement officials. Moreover, this enforcement concept raises significant constitutional, legal, and operational issues.

Resolution of these concerns would necessarily have to precede any policy decision requiring the installation of speed-monitoring devices.

Based on the findings of this study, the agency concludes that the Federal ***mandating*** of speed control devices on combination-unit trucks does not appear to be justified at this time. Problem size statistics suggest that the number of target crashes is low, especially when viewed against the overall truck crash picture or against the overall problem of highway speeding. Speed-limiting devices would not dramatically change the distribution of truck speeds on the highways, since most trucks now travel at speeds below levels likely to be set by the devices, and those that are currently traveling at higher speeds are typically traveling at speeds just a few miles per hour higher. It is not certain whether the marginal reduction of speed for these vehicles would actually reduce their crash risk (or resulting fatality risk) significantly, since other, nonspeed-related driver errors may still occur and cause similar crashes and injuries. For all of these reasons, the potential effectiveness of mandatory speed limitation in terms of either crash reduction or lives saved is questionable.

Numerous, complementary approaches to truck speed control are already operative at the levels of vehicle design, fleet management practice, and driver licensing. Two current trends in particular--the development and market penetration of electronic engine controls and the establishment of the Commercial Driver's License Program--are expected to further mitigate against truck speeding. The CDL Program targets flagrant and/or repeat speeding offenders, the same operators who would be most likely to defeat or circumvent mandatory speed-limiting devices.

All motorists--commercial and private vehicle operators alike--need to do a better job of voluntarily complying with posted speed limits on highways. Highway speeding appears to be a widespread highway safety concern that is not limited to commercial motor vehicles. Public information and education programs, coupled with increased speed enforcement (for all vehicle types) may be the best method of achieving improved highway speed limit compliance.

# 1.0 INTRODUCTION

The National Highway Traffic Safety Administration (NHTSA) has prepared this report on heavy truck speed control devices in response to Section 9108 of the Truck and Bus Regulatory Reform Act of 1988, Public Law 101-690, dated November 18, 1988, which reads as follows:

> "The Secretary shall conduct a study on whether or not devices which control the speed of commercial motor vehicles enhance safe operation of such vehicles . . . (and) ... not later than thirty months after the date of enactment of this Act, ... shall submit to Congress a report on the results of the study . . . together with recommendations . . . on whether or not to make the use of speed control devices mandatory for commercial motor vehicles."

The "commercial vehicles" addressed in this report are medium and heavy trucks (Gross Vehicle Weight Rating > 10,000 lb.), with emphasis on combination-unit trucks (tractor trailers).

## 1.1 Problem Background

The Surface Transportation and Uniform Relocation Assistance Act of April 1987 allowed states to increase the speed limits on rural Interstates from 55 miles per hour (mph) to 65 mph. In 1987-88, 40 states instituted 65 mph limits for rural Interstates, some with restrictions on medium/heavy trucks (e.g., a lower speed limit such as 55 mph for trucks). The majority of the Interstate highway system in rural areas is now posted at 65 mph for trucks and other vehicles.

Many vehicles of all types regularly travel at highway speeds greater than the posted speed limit. This poor speed limit compliance, coupled with the size differential between large trucks and passenger vehicles, has raised the question of whether there would be significant safety gains from the limitation of truck highway speeds. Devices that prevent or minimize truck speeding include those that limit maximum vehicle speed (governors) and those that monitor and record vehicle speed. Speed governors would, in most cases, need to be set at 65 mph or greater (a hypothetical value of 70 mph is used here), since any governor set below 65 mph would prevent the vehicle from traveling at the legal speed limit on 65 mph roadways.

Speed recording devices, though not a direct "speed control," are also available to help fleet managers monitor the speed limit compliance of their drivers. Monitors are potentially applicable to achieving speed compliance on 55 mph roadways (or even lower-speed roadways) as well as 65 mph roadways when managers know the speed limits on the roadways traveled by their fleet vehicles.

To assess the safety importance of truck speeding and potential benefits of speed control devices, this report first assesses the incidence of truck speeding and its relation to truck crashes. The report focuses on the prevalence of truck speeding and crashes at speeds greater than 65 mph, since they would be the prime targets of speed control devices. Data are also presented relating to speeding at speeds below 65 mph, since speed monitors could be applied to that problem. Following the presentation of statistics on speed compliance and speeding-related crashes, the characteristics and current and potential applications of truck speed-limiting and monitoring devices are addressed. From this, recommendations are offered on ways to improve fleet speed limit compliance and regarding the question of whether the use of truck speed-limiting devices should be made mandatory in the United States.

## 1.2 Overview of the Medium/Meaw Truck Crash Experience in the U.S.

Before addressing safety considerations relevant to truck speeding, it is worthwhile to review the overall truck accident picture. Table P-l presents an overview of the medium/heavy truck police-reported crash experience in the United States based on data from the NHTSA General Estimates System (GES), Fatal Accident Reporting System (FARS), and Federal Highway Administration (FHWA) statistics on annual vehicle miles traveled (VMT) and vehicle registrations. Comparative statistics are provided for combination-unit trucks, single-unit trucks, and "passenger vehicles," which, for the purposes of this report, are defined as all vehicles ***other than*** medium/heavy trucks. Approximately 97 percent of the "'passenger vehicle" category consists of automobiles and light trucks/vans. Motorcycles, buses, and other miscellaneous vehicles are included in the "passenger vehicle" category. Throughout this report, crash statistics are, when possible, presented separately for combination-unit trucks and single-unit trucks, since the crash experiences of these vehicle types are very different from each other.

The data indicate that ***single-unit*** trucks are significantly under-involved in crashes relative to other vehicle types. This is true for all measures of crash involvement shown, with the one exception of overall crash involvement rate, which is similar for single-unit and combination-unit trucks.

The crash involvement picture for combination-unit trucks is considerably more complex. Combination-unit trucks constitute 0.8 percent of registered vehicles, but represent 1.9 percent of motor vehicle involvements in police-reported crashes. Furthermore, they constitute 6.6 percent of motor vehicle involvements in fatal crashes. Combination trucks travel on average more than 60,000 miles per year, compared to about 10,000 miles for the average passenger vehicle. They have a far greater exposure than other vehicle types to the possibility of involvement in a crash, and this increased exposure contributes to their overrepresentation in fatal crashes.

Combination-unit trucks have a police-reported crash involvement rate of 244.0 per 100 million vehicle miles traveled (VMT), which is less than half the rate for passenger vehicles. However, the fatal crash involvement rate of combination-unit trucks (4.5 per 100 million VMT) is greater than that of passenger vehicles (3.0 per million VMT).

The number of combination-unit truck crash involvements per 1,000 vehicles per year is more than twice that of passenger vehicles, and nearly five times that of single-unit trucks. The number of combination-unit truck involvements in ***fatal*** crashes per 1,000 vehicles is approximately nine times higher than that of passenger vehicles or single-unit trucks.

**Table l-l: Summary of the U.S. Medium/Heavy Truck Crash Experience in Relation to Other Vehicles**

| Statistic — Vehicle Type: | Comb-Unit Trks | Sngl-Unit Trks | Pass. Vehs. |
|---|---|---|---|
| Vehicle Registrations (FHWA, 1988) (Percent of Total) | 1,476,241 (0.8%) | 3,957,319 (2.1%) | 183,547,456 (97.1%) |
| Annual Vehicle Involvements in Crashes (1988-89 Average, GES) (Percent of Total) | 220,000 (1.9%) | 122,000 (1.0%) | 11,440,000 (97.1%) |
| Annual Vehicle Involvements in Fatal Crashes (1988-89 Average, FARS) (Percent of Total) | 4,063 (6.6%) | 1,051 (1.7%) | 56,612 (91.7%) |
| Annual VMT (Millions; FHWA, 1988) (Percent of Total) | 90,149 (4.5%) | 51,231 (2.5%) | 1,884,207 (93.0%) |
| Average Annual VMT Per Vehicle (Miles) | 61,067 | 12,946 | 10,266 |
| Police-Reported Crash Involvement Rate (Per 100 Million VMT) | 244.0 | 238.1 | 607.2 |
| Fatal Crash Involvement Rate (Per 100 Million VMT) | 4.5 | 2.1 | 3.0 |
| Annual Crash Involvements Per 1,000 Vehicles | 149.0 | 30.8 | 62.3 |
| Annual Fatal Crash Involvements Per 1,000 Vehicles | 2.8 | 0.3 | 0.3 |

Notes: 1) "Passenger Vehicles" are here defined as all vehicles other than combination-unit or single-unit medium/heavy trucks. The "passenger vehicle" category includes approximately **97 percent** automobiles and light truck/vans, and approximately 3 percent miscellaneous vehicles such as buses and motorcycles. 2) The distinction between "vehicle involvements in crashes" and "crashes" is noteworthy. A particular crash may involve a single vehicle or multiple vehicles. For example, in 1988-89 there was an annual average of 41,418 fatal crashes involving 61,726 vehicles. The average number of persons killed was 46,324.

Not shown in **Table 1-1** is the distribution of fatalities resulting from combination-unit truck crashes (statistics not shown in **Table 1-1).** In 1988-89, there were an average of 4,063 combination-unit truck fatal crash involvements, resulting in 4,494 fatalities. Of these, 3,742 (84.4 percent) were either non-occupants (e.g., pedestrians) or occupants of other involved - vehicles; 702 (15.6 percent) were truck occupants (drivers or passengers).

Combination-unit trucks accumulate about 49 percent of their mileage on the Interstate highway system, versus 22 percent for single-unit trucks and 20 percent for passenger vehicles. The Interstate highway system has the lowest fatal crash rate of all major road types (1988 FARS Annual Report). For example, only about 26 percent of combination-unit truck involvements in fatal crashes occur on Interstate highways (FARS, 1988) a percentage considerably lower than the exposure percentage (49 percent) cited above. For both single-unit trucks and passenger vehicles, the percentage of involvements occurring on Interstate highways is about 10 percent (FARS, 1988).

On rural Interstate highways, which now are generally 65 mph highways (and represent virtually the only 65 mph highways in the United States), the exposure differences between combination-unit trucks and other vehicle types are even more striking. Combination-unit trucks accumulate 31 percent of their mileage on rural Interstate highways, an average of about 19,000 rural Interstate miles per vehicle. Single-unit trucks are driven 11 percent of their mileage on rural Interstates (about 1,400 miles per vehicle), and passenger vehicles are driven only 8 percent of their miles on rural Interstates (about 800 miles per vehicle).

The above differences in exposure to 65 mph roadways are reflected in vehicle type differences in their proportions of crash involvements occurring on roadways with different speed limits. **Table** 1-2 shows the distribution of crash involvements and fatal crash involvements by roadway posted speed limit for the three vehicle type categories.

Not all rural Interstate highways have 65 mph speed limits, particularly for trucks. At this writing, approximately 90 percent of rural Interstate miles are posted at 65 mph for cars, and approximately 56 percent are posted at 65 mph for trucks. Combination-unit trucks accumulate a large percentage of their mileage on these roadways, which have the lowest overall crash rates of any major roadway class (Shelton, 1990). These low crash rates are reflected in the relatively low percentage of combination-unit truck crashes that occur on 65 mph highways (6.4 percent) relative to combination-unit truck exposure on these highways (approximately 56 percent of 31.2 percent, or 17 percent). Ironically, however, public safety concerns regarding vehicle speeding are perhaps greatest in relation to the Interstate highway system (e.g., NHTSA, 1989; McKnight Klein, and Tippetts, 1989).

A final notable trend regarding heavy truck safety is the dramatic decreases in crash rates over the past decade. The fatal crash involvement rate **for** all medium/heavy trucks combined was 3.7 per 100 million vehicle miles of travel in 1988, an all-time low. Between 1977 and 1988, the fatal crash involvement rate for combination-unit trucks decreased 40 percent and the rate for single-unit trucks decreased by close to one-third, whereas the rate for passenger vehicles (cars/light trucks and vans) decreased only 25 percent. The efforts of motor carriers and their drivers, coupled with expanded state-Federal programs to license commercial drivers, and inspect vehicles at roadside, all seem to be having a positive effect on truck crash involvements.

**Table 1-2: Crash Involvements and Fatal Crash Involvements by Posted Speed Limit**

| Statistic Vehicle Type: | Comb-Unit Trks | Sngl-Unit Trks | Pass Vehs |
|---|---|---|---|
| Annual Crash Involvements (GES, 88-89 Avg) | 220,000 | 122,000 | 11,440,000 |
| Est Crash Involvements, PSL=65 mph Column % | 14,200 (6.4%) | 3,400 (2.8%) | 111,700 (1.0%) |
| Est Crash Involvements, 55<=PSL<=64 mph Column % | 90,200 (41.0%) | 39,300 (32.3%) | 2,071,700 (18.1%) |
| Est Crash Involvements, PSL<=54 mph Column % | 115,600 (52.5%) | 79,200 (65.0%) | 9,256,900 (80.9%) |
| Annual Fatal Crash Involvements (FARS, 88-89 Avg) | 4,063 | 1,051 | 56,612 |
| Fatal Crash Involvements, PSL = 65 mph Column % | 568 (14.0%) | 33 (3.1%) | 2,415 (4.3 %) |
| Fatal Crash Involvements, 55< =PSL< =64 mph Column % | 2,400 (59.1%) | 516 (49.1 %) | 26,065 (46.0%) |
| Fatal Crash Involvements, PSL < =54 mph Column % | 1,095 (27.0 %) | 502 (47.8%) | 28,191 (49.7 %) |

Note: Data represent all GES and FARS crash involvements. Cases with unknown posted speed limits (34.2 percent of GES cases, 2.4 percent of FARs cases) have been proportionately allocated among the three PSL categories.

## 1.3 Vehicle Sseed and Crash Severity

Truck speeding--indeed, speeding by any vehicle--is a concern because of the strong relationship between vehicle speed and occupant injury severity. Studies of occupant injuries (e.g., Malliaris, Hitchcock, and Hedlund, 1982) have shown that the principal determinant of occupant trauma level resulting from a collision is the ***change*** of vehicle speed upon impact, or **Delta V.** This relationship is shown in **Figure P-l.**

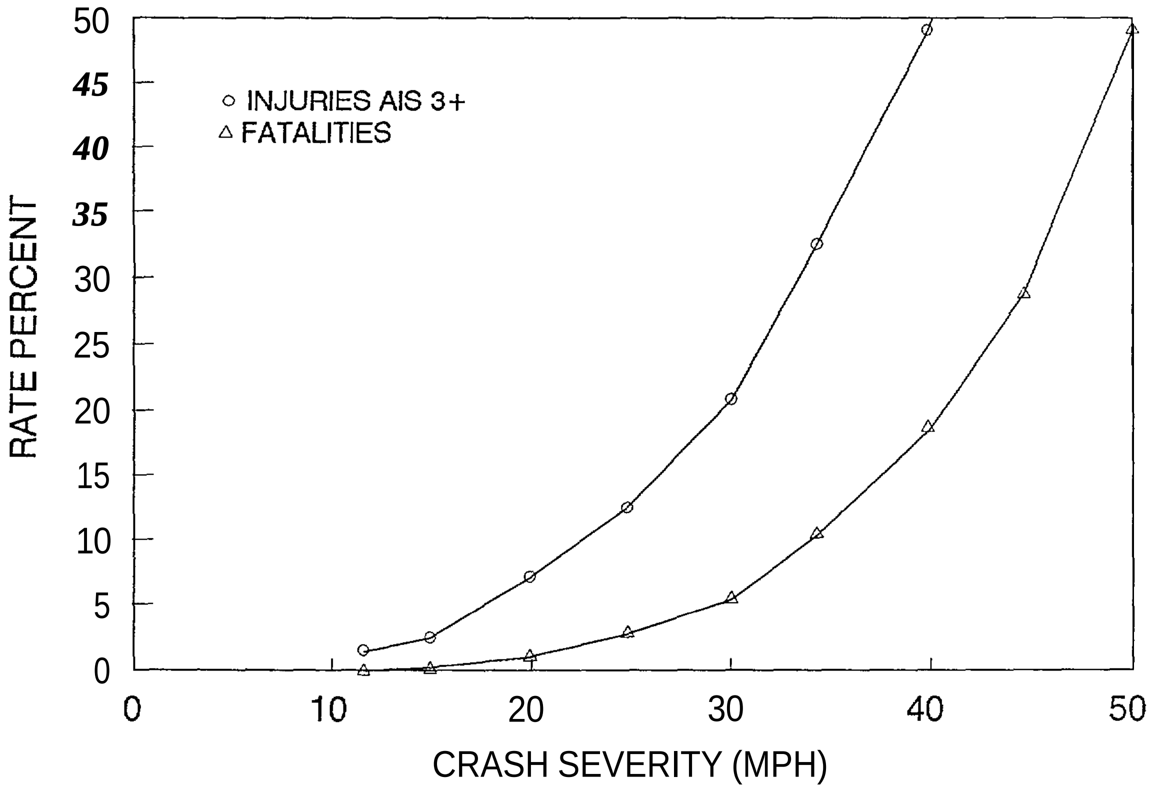


**Figure 1-1: Relationship between passenger vehicle crash severity (Delta V) and vehicle occupant injury/fatality probability** (Malliaris, 1982, based on data from the National Crash Severity Study; AIS 3 + injuries are those that are "serious" or of greater severity on the 6-point Abbreviated Injury Scale)

Delta V is not the same as precrash vehicle travel speed. Some braking may occur before impact, and often much deceleration occurs after impact as vehicles roll or slide to a stop. Many crashes occurring on high-speed roadways involve relatively low Delta Vs (e.g., sideswipes). Nevertheless, high vehicle travel speeds create the potential for high Delta Vs in a collision. And, the relationship shown in **Figure 1-1** (for a sample of passenger vehicles involved in crashes) demonstrates that higher Delta Vs are associated with greatly increased injury potential.

## 1.4 Factors Influencing Truck heeding

Commercial vehicle drivers are often under pressure to move goods as rapidly as possible. For many operators, the adage "time is money" holds much truth. Long-haul trucks operate in a highly competitive environment where shippers may demand very tight delivery schedules. The current trend toward just-in-time delivery is economically attractive to manufacturers and distributors, but can result in added schedule pressure on truckers.

Long-haul trucks compile the vast majority of their miles on highways, principally Interstates. Speed limit compliance on these roadways is poor for all vehicle types. On most highways, the ***majority*** of vehicles exceed the posted speed limit (Pezoldt and Brackett, 1989; see Chapter 2). Thus, if compliance with highway speed limits were equivalent for trucks and cars (i.e., if trucks were just "keeping up with traffic"), trucks would still have a much greater exposure to high speed driving situations. Chapter 2 of this report provides data which show that trucks are generally more compliant with highway speed limits than are cars, and data presented in Chapter 3 indicate that a smaller percentage of their involvements in crashes are speed-related. But trucks have a far greater exposure than other vehicles to high speed highway situations. This increases their ***likelihood*** of involvement in a speed-related crash during any given time period.

A factor contributing to truck speeding is detection by truck drivers of enforcement efforts. The resourceful tactics used by some long-haul truck drivers to avoid speed limit enforcement by police are well known. Virtually all long-haul trucks are equipped with CB radios, which can be used to evade police speed limit enforcement efforts. In addition, studies indicate that roughly one fourth of combination-unit truck tractors are equipped with radar detectors (see Section 2.1).

Opposed to the above factors are a number of other factors acting to prevent long-haul trucks from speeding. The "time is money" factor is counterbalanced to some extent by economic incentives for speed compliance relating to fuel economy, vehicle maintenance economy, and insurance/crash costs. For example, fuel economy improves by roughly 1 percent for each 1 mph reduction in speed in the 55-70 mph range for conventional diesel trucks (estimated from Weiss et al, 1982).

Professional truck drivers also have a strong economic incentive to avoid speeding citations. Multiple speeding citations can lead to commercial driver's license suspension -- an economic catastrophe for most drivers. Moreover, a cooperative Federal-state program now exists to ensure that only one commercial driver's license is issued to any individual, and that convictions for certain traffic violations committed in a commercial motor vehicle occurring anywhere in the United States are reported to the licensing state and made a part of the driver's record. This system, termed the Commercial Driver's License Information System (CDLIS), is a critical component of the entire Commercial Driver's License (CDL) program. This program provides a mechanism for the exchange of information among states in order to prevent drivers from obtaining multiple licenses and/or accumulating multiple speeding convictions in different states with impunity. Section 1.5 below specifically addresses this program and describes its potential effects on drivers with serious speeding violations.

There are also public relations incentives relating to speed compliance and safe driving in general. A majority of combination-unit trucks have their company names prominently displayed on the trailer and/or the tractor cab, and many vehicles display an explicit sign with a statement such as, “If you see this vehicle operated unsafely, please call xxx-xxx-xxxx.” In these respects, many commercial vehicle drivers, unlike private vehicle drivers, are constantly under public surveillance, with a resultant possibility of sanctions for unsafe driving acts.

Many trucking fleets are organized to permit some degree of management control over vehicle highway speeds, independent of any mechanical or legal speed-limiting factors. Records are maintained of vehicle travel times between terminals, fuel economy, maintenance record, complaints of the public or other drivers, and other data that may be relevant to speeding by drivers. Some fleets even employ their own road patrols to identify unsafe drivers. At a management level, there are strong economic incentives for minimizing accident rates, in particular those involving unsafe driving acts by drivers.

Finally, a major topic addressed in this report is the use of electronic and mechanical devices to limit truck speed. This includes speed-limiting devices such as engine speed governors--mechanisms built into the engine that limit engine revolutions per minute (rpm). The new generation of electronically-controlled engines have speed-limiting capabilities that greatly enhance the ability of fleet managers to prespecify the maximum cruising speeds of their vehicles. In addition to engine speed governors, there are supplemental devices such as cruise control that limit truck speed.

Also addressed are monitoring devices such as on-board computers which provide a continuous record of vehicle speed. Monitoring devices do not directly limit vehicle speed but may be used to indirectly control speeds by providing fleet management with a continuous record of vehicle speed. Moreover, monitoring may be applied to controlling speeds on both 65 mph and 55 mph roadways, if the roadway speed limits are known by management. The speed-reduction effectiveness of speed monitoring is predicated, however, on a review of the continuous speed record by management or some other authority.

In summary, while there are economic and other disincentives for speed compliance by truck drivers, there are also very strong incentives for speed compliance. At the fleet management level, there are a number of means available to monitor and control fleet highway speeds. A pervasive theme of this report is that much responsibility falls on fleet management for initiating and sustaining efforts, be they device-related or purely managerial, to maximize speed limit compliance by their drivers.

## 1.5 Programs to Improve Speed Enforcement: Commercial Driver's License Program and Commercial Vehicle Enforcement Pilot Project

The principal goal of the Commercial Motor Vehicle Safety Act of 1986 was to improve highway safety by ensuring that drivers of large trucks and buses are qualified to operate those vehicle on the highway. The Act retained each state's right to issue a commercial driver's license (CDL) but established minimum Federal standards which states must meet when licensing commercial motor vehicle drivers.

The Federal Highway Administration (FHWA) is currently working with the states and the District of Columbia to implement the CDL program. As of March 1, 1991, 34 licensing jurisdictions are issuing CDLs. The Act requires that all commercial motor vehicle operators have a CDL by April 1, 1992.

A critical component of the CDL program is the disqualification of commercial drivers for conviction of certain offenses committed while driving a commercial motor vehicle. These disqualifications (loss of driving privileges) may range in length from 60 days to life, depending on the nature and number of recurrences of the offense. For example, a driver can be disqualified for 60 to 120 days for conviction of two or more "serious traffic violations" within a three-year period. "Serious traffic violations" include improper or erratic lane changes; reckless driving; following too closely; and, most relevant to this report, excessive speeding (defined as 15 mph or more in excess of the posted speed limit).

For driver disqualification purposes, convictions for out-of-state violations are treated the same as convictions for violations committed in the home state. State participation in the CDL program and its licensing/violations database, the Commercial Driver License Information System (CDLIS), ensures that any conviction a driver receives outside his or her home state will be transmitted to the home state so that disqualifications are enforced. Convictions for traffic violations committed in a commercial motor vehicle become part of the driver's permanent driving record.

This cooperative Federal-state program now functions as an enforcement "backstop" to the other speed control approaches--e.g., speed control devices and fleet management approaches--addressed in this report. In the context of truck speeding, the most important contribution of the CDL program is the disqualification of chronic and/or flagrant speeding offenders from commercial motor vehicle operation.

Complementing the CDL program are initiatives intended to enhance speed limit compliance enforcement on the highways. For example, the Commercial Vehicle

Enforcement Pilot Project (CVEPP) is a joint effort involving NHTSA, FHWA, the California Highway Patrol (CHP), and other state and local government jurisdictions. CVEPP is intended to reduce truck crashes through heightened public and industry awareness of local truck safety problems and identification and promulgation of successful strategies to enhance ongoing commercial vehicle enforcement efforts. CVEPP is oriented toward the mitigation of primary collision-causing commercial motor vehicle violations on highways (e.g., Interstates); speeding is one of the principal moving violations resulting in enforcement stops and safety inspection. Currently, there are CVEPP sites in six states. Enforcement methods tested and refined during the pilot program are expected to be implemented on a national scale in cooperation with participating local and state jurisdictions in the coming decade.

## 1.6 Overview of Report Organization

The remainder of this report is organized to address the following major issues and questions regarding commercial vehicle speed control:

- How good is the highway speed limit compliance of heavy commercial vehicles? How does it compare to other vehicles?
- To what extent are speeding and, specifically, speeding at greater than 65 mph and 70 mph, involved as causal or contributing factors in traffic crashes? How **does** the level of speeding involvement for trucks compare to that of passenger vehicles?
- What electromechanical devices are available to control truck speed? How can trucks be designed to provide built-in limitations to maximum vehicle speed?
- How do fleet managers use speed control devices? What management approaches are most effective in ensuring speed compliance by drivers?
- Should the use of speed control devices--speed-limiting and/or speed monitoring--be mandated on medium/heavy trucks?

# 2.0 TRUCK TRAVEL SPEED STATISTICS

This chapter presents statistics on the prevailing highway travel speeds of heavy trucks and other vehicles. It addresses the incidence of truck speeding and speeding over 65 mph and 70 mph, and compares statistics on the highway travel speeds of trucks to those of other vehicles. Virtually all of the highway observations reported were taken at level sites; thus, the data cited do not reflect downhill truck speeds, which may be significantly greater than speeds on level terrain or on upgrades. However, downhill speeds are not of particular interest here since speed-limiting devices would not affect truck free-roll downhill speeds.

## 2.1 Detectable vs. Nondetectable Radar: 1987 IIHS Study

Studies of vehicle travel speeds employing conventional radar systems are likely to yield estimates of highway travel speeds that are spuriously low. This is because a significant number of vehicles, especially heavy trucks, are equipped with radar detectors. Vehicles so equipped will typically slow down when they encounter an active radar system, thus invalidating conventional radar measurements.

The Insurance Institute for Highway Safety (1987) reported research performed in Virginia and Maryland showing that 11 percent of speeding vehicles (i.e., vehicles traveling at greater than or equal to 62 mph in a 55 mph zone) slowed by at least 5 mph when a police radar was activated. Twenty-five percent of the combination trucks slowed down, indicating that a much larger percentage of combination trucks were equipped with radar detectors. From these statistics and other reports of frequent radar detector use in combination trucks, one may conclude that conventional radar studies of travel speeds underestimate both the absolute number of heavy trucks that speed, and their relative likelihood of speeding compared to other vehicles.

Although a larger percentage of heavy trucks are equipped with radar detectors, studies employing ***nondetectable*** radar provide no indication that heavy trucks actually travel at higher highway speeds than do passenger vehicles. For example, **Table 2-1,** based on the same series of tests, compares the travel speeds of different vehicle types as measured by nondetectable radar versus conventional detectable police radar. The difference between the detectable and nondetectable conditions was greatest for combination-unit trucks, suggesting that a larger percentage are equipped with radar detectors. Nevertheless, a comparison of vehicle types in the nondetectable radar condition does not indicate that tractor-trailer travel speeds are higher than those of other vehicle types. The percentage of combination-unit trucks traveling at > 65 mph was slightly higher than that of passenger cars, however.

## 2.2 Studies of Highway Travel Speeds Employing Nondetectable Measures

### 2.2.1 Pezoldt and Brackett (1989)

Pezoldt and Brackett (1989) reported more extensive data comparing the highway speeds of trucks and other vehicles as measured by detectable versus nondetectable radar at 14 locations in four states. The vast majority of the "trucks" in the Pezoldt and Brackett study were combination-unit trucks. All data were collected during daylight hours. Corroborating the IIHS study cited above, their data suggest that many more heavy trucks than other vehicles are equipped with radar detectors.

**TABLE 2-l: AVERAGE TRAVEL SPEEDS AND PERCENTAGE OF VEHICLES TRAVELING AT A SPEED OF > 65 MPH FOR VARIOUS VEHICLE TYPES A§ MEASURED BY NONDETECTABLE AND DETECTABLE POLICE RADAR.** (Data collected in late 1986 on 14 55 mph highways in Maryland and Virginia; Insurance Institute for Highway Safety, 1987)

| | AVERAGE SPEED | | | PERCENT > 65 MPH | | |
|---|---|---|---|---|---|---|
| | Nondetectable Radar | Detectable Radar | Difference | Nondetectable Radar | Detectable Radar | % Change |
| Passenger Cars | 60.2 | 59.9 | - 0.3 | 16.1% | 15.8% | - 2% |
| Sport/Spec Cars | 61.4 | 59.7 | - 1.7 | 23.7% | 17.9% | - 24% |
| Light Trucks | 59.8 | 59.0 | - 0.8 | 15.2% | 13.3 % | - 12% |
| Heavy Single-Unit Trucks | 58.0 | 57.8 | - 0.2 | 10.0% | 8.4% | - 16% |
| Combination-Unit Trucks | 60.0 | 57.8 | - 2.2 | 17.9% | 9.4% | - 47% |

Nondetectable radar measurements showed that both trucks and passenger vehicles frequently traveled at speeds exceeding posted limits and 65 mph. However, the majority of the data suggested that trucks travel at a high speed less frequently than do passenger vehicles. **Table** 2-2 was compiled from Pezoldt's and Brackett's nondetectable radar observations to show the percentage of trucks and passenger vehicles traveling at speeds greater than the posted speed limit (generally 55 mph) and the percentage traveling at greater than ***65*** mph. For both vehicle types, the percentages varied greatly, reflecting local roadway, traffic, and enforcement conditions. At most locations, a greater percentage of passenger vehicles than trucks traveled at speeds above the posted speed limit. Overall, under 11 conditions where the posted speed limit was the same for trucks and passenger vehicles, the **weighted** mean percentages for trucks (N = 2,493) were 64.6 percent exceeding the posted speed limit and 15.6 percent exceeding

TABLE 2-2: PERCENTAGE OF TRUCKS AND PASSENGER VEHICLES EXCEEDING THE POSTED SPEED LIMIT AND 65 MPH BASED ON NONDETECTABLE RADAR TESTS AT 13 HIGHWAY LOCATIONS IN 4 STATES. (from Pezoldt and Brackett, 1989; SL = speed limit; N = Sample Number).

| State | Roadway Type | Trk SL | N Trks | %Trks>SL | %Trks>65 | PV SL | N PV | %PV>SL | %PV>65 |
|---|---|---|---|---|---|---|---|---|---|
| NM | Interstate | 55 | 89 | 73.0% | 14.6% | 55 | 209 | 82.8% | 26.3% |
| NY | Interstate | 55 | 894 | 82.0% | 8.6% | 55 | 1,274 | 95.4% | 35.2% |
| OH | Interstate | 55 | 2,197 | 75.8% | 4.1% | 65 | 2,049 | (35.6%)* | (35.6%)* |
| OH | Interstate | 55 | 292 | 40.8% | 1.4% | 55 | 389 | 81.8% | 14.7% |
| TX | Interstate | 55 | 65 | 86.2% | 12.3% | 55 | 77 | 89.6% | 22.1% |
| NY | 4 Ln Divided, Non-Interstate | 55 | 250 | 68.4% | 5.6% | 55 | 902 | 82.0% | 19.6% |
| NY | 2/4 Lane, Non-Interstate | 55 | 37 | 46.0% | 2.7% | 55 | 188 | 56.4% | 6.9% |
| OH | 4 Ln Divided, Non-Interstate | 55 | 24 | 50.0% | 0.0% | 55 | 166 | 70.5% | 11.5% |
| OH | 2 Lane, Non-Interstate | 55 | 67 | 65.7% | 4.5% | 55 | 146 | 65.8% | 5.5% |
| TX | 4 Ln Divided, Non-Interstate | 55 | 141 | 90.0% | 21.3% | 55 | 528 | 82.8% | 16.7% |
| TX | 2 Lane, Non-Interstate | 55 | 36 | 83.3% | 5.6% | 55 | 260 | 78.5% | 15.0% |
| TX | Rural Interstate | 60 | 328 | 59.2% | 22.9% | 65 | 404 | (45.3%)* | (45.3%)* |
| NM | Rural Interstate | 65 | 598 | 39.5% | 39.5% | 65 | 1,155 | 54.2% | 54.2% |
| | **Unweighted Means, 11 Same-SL Locations** | | | **65.9%** | **10.6%** | | | **76.3%** | **20.7%** |
| | **Total Ns and Weighted Means, Same-SL Locations** | | **2,493** | **64.6%** | **15.6%** | | **5,294** | **75.7%** | **29.2%** |

* At those sites where there were different speed limits for trucks and passenger vehicles, the percentages for passenger vehicles are shown in parentheses since they are not directly comparable to those of trucks. Percentages for these two locations are **not** included in the means.

65 mph. For passenger vehicles (N = 5,294), the corresponding percentages were 75.7 percent and 29.2 percent. The data shown in Table 2-2 indicate poor compliance with posted speed limits for both trucks and passenger vehicles; however, compliance is better among trucks than among passenger vehicles.

### 2.2.2 Mace and Heckard (1990)

Mace and Heckard (1990) reported on truck and passenger vehicle speed characteristics after the 65 mph speed limit was implemented on rural Interstates. Data were collected in four states which had raised the nontruck rural Interstate speed limit from 55 mph to 65 mph. Data from two states (Illinois and California) which maintained the 55 mph speed limit for trucks were compared to data from two states (Alabama and Arizona) which increased the truck speed limit to 65 mph. Speed measurements were taken in 1989 at 24 rural Interstate sites. Summary statistics of the results are shown in **Table 2-3.**

TABLE 2-3: TRUCK AND PASSENGER VEHICLE MEAN TRAVEL SPEEDS AND PERCENT OF VEHICLES EXCEEDING 55 MPH AND 65 MPH AT 24 SITES IN 4 STATES. (All four states have 65 mph speed limits for passenger vehicles. Illinois and California have 55 mph speed limits for trucks; Alabama and Arizona have 65 mph speed limits for trucks; Mace and Heckard, 1990)

| State | # Sites | SL | Avg TS | % > 55 | % > 65 |
|---|---|---|---|---|---|
| IL | 13 | Trk: 55<br>PV: 65 | Trk: 58.32<br>PV: 63.43 | Trk: 74.6%<br>PV: 88.3% | Trk: 12.3%<br>PV: 36.1% |
| CA | 4 | Trk: 55<br>PV: 65 | Trk: 57.18<br>PV: 65.25 | Trk: 75.0%<br>PV: 91.5% | Trk: 12.6%<br>PV: 49.1% |
| AL | 4 | Trk: 65<br>PV: 65 | Trk: 64.68<br>PV: 68.55 | Trk: 95.8%<br>PV: 98.1% | Trk: 38.4%<br>PV: 69.6% |
| AZ | 3 | Trk: 65<br>PV: 65 | Trk: 64.90<br>PV: 68.43 | Trk: 93.1%<br>PV: 97.4% | Trk: 46.8%<br>PV: 71.7% |

Major findings apparent in **Table** 2-3 include the following:

- Speed limit compliance was poor (generally less than 50 percent) for both vehicle types.

- **Trucks** exhibited lower average travel speeds, a lower percentage of vehicles exceeding 55 mph, and a lower percentage of vehicles exceeding 65 mph than did passenger vehicles. This was true in all four states.

- Average truck highway speeds were lower in the two states (Illinois and California) with 55 mph speed limits for trucks than they were in the two states (Alabama and Arizona) with 65 mph speed limits for trucks.

- In states with uniform speed limits (i.e., 65 mph for both trucks and passenger vehicles), average truck travel speeds were 3-4 mph lower than passenger vehicle travel speeds. The percentages of trucks exceeding the speed limit were smaller than those for passenger vehicles.

- In the two states with differential speed limits for trucks and passenger vehicles (Illinois and California), truck compliance with the 55 mph speed limit was poor. About 75 percent of trucks exceeded the 55 mph speed limit.

- In the two states with uniform speed limits (i.e., 65 mph for both trucks and passenger vehicles), the percentages of trucks exceeding the speed limit were lower than those for states with differential speed limits. The percentages were 38.4 percent in Alabama and 46.8 percent in Arizona.

Mace and Heckard (1990) also measured truck and passenger vehicle speeds at 18 "local spillover" sites in four states: Alabama, Arizona, California, and Tennessee. The "spillover" sites were on rural arterials posted at 55 mph and located *near* rural Interstates where the speed limit for passenger vehicles was 65 mph and for trucks was either 55 mph (California) or 65 mph (Alabama, Arizona, Tennessee). "Toward" sites were those where traffic was on the arterial traveling toward the Interstate; "away" sites were those where traffic was traveling away from the Interstate. **Table 2-4** shows the results.

TABLE 2-4: AVERAGE TRUCK AND PASSENGER VEHICLE TRAVEL SPEEDS AT LOCAL SPILLOVER SITES (Mace and Heckard, 1990)

| State | # Sites | Avg Trk TS "Toward" | Avg Trk TS "Away" | Avg PV TS "Toward" | Avg PV TS "Away" |
|---|---|---|---|---|---|
| AL | 5 | 54.3 | 55.7 | 57.1 | 57.6 |
| AZ | 3 | 56.0 | 58.3 | 58.5 | 59.6 |
| CA | 1 | 47.3 | 46.5 | 58.5 | 59.1 |
| TN | 9 | 53.3 | 54.5 | 55.6 | 56.2 |
| Average All Sites | 18 | 53.7 | 55.0 | 56.7 | 57.3 |
| Unweighted Avg 4 States | | 52.7 | 53.7 | 57.4 | 58.1 |

Key results of the "spillover site" study (see Table 2-4) were as follows:

- In all four states and at both "toward" and "away" sites, average truck speeds were lower than average passenger vehicle speeds.

- With one exception (trucks at the California site), average "away" travel speeds were slightly higher than "toward" travel speeds.

- The California site exhibited the lowest average truck speeds in both the "toward" and "away" conditions. California was the only state of the four where the truck speed limit on the nearby Interstate was 55 mph instead of 65 mph.

### 2.2.3 Recent IIHS Studies

The Insurance Institute for Highway Safety (IIHS) has conducted time series studies of highway travel speeds in a number of states to determine the effect of increased rural Interstate speed limits on vehicle travel speeds (Esterlitz et al, 1989; Freedman and Esterlitz, 1990). One focus of these studies was the effects of uniform speed limits (e.g., 65 mph for both trucks and passenger vehicles) versus the effects of differential speed limits (i.e., 55 mph for trucks, 65 mph for passenger vehicles).

**Table** 2-5 presents IIHS statistics (Esterlitz et al, 1989) taken in 1988 from four states: two uniform 65/65 (Arizona and Iowa) and two differential truck 55/PV 65 (Illinois and California). Travel speeds were recorded from in-pavement induction loops or loop mats; all vehicles greater than 20 feet in length were classified as "trucks." Thus, this category includes single-unit trucks, buses, and other large vehicles. In all there were approximately 60,000 vehicle observations. Truck highway travel speed averaged less than the speed limit in 65 mph states, but greater than the speed limit in 55 mph states. In all four states, trucks had lower average travel speeds and a smaller percentage of vehicles exceeding 70 mph. Not surprisingly, this difference was greatest for the two states with differential speed limits for cars and trucks.

Table 2-6 contains data collected by IIHS (Freedman and Esterlitz, 1990) in .Iune, 1989 in three states: New Mexico (uniform 65/65), Virginia (differential 55 trucks, 65 passenger vehicles), and Maryland (uniform 55). Speeds were recorded using a nondetectable K-band radar, and vehicle types were recorded by observers. In this study, all "trucks" were tractor-trailers. The study results, representing a total of approximately 5,500 vehicle observations, corroborate those shown in Table 2-5. Moreover, data collected at the same sites in 1988 and earlier in 1989 as part of the same study yielded similar results.

Also apparent in the Freedman and Esterlitz (1990) data is the fact that the percentage of speeding trucks decreases, relative to passenger cars, at higher travel speeds. Thus, in the

Maryland data, one sees that the percentage of trucks traveling at >65 mph is 80 percent of the passenger vehicle percentage, but that the percentage of trucks traveling at >70 mph is only 37 percent of the passenger vehicle percentage.

**TABLE 2-5: TRUCK AND PASSENGER VEHICLE MEAN TRAVEL SPEEDS AT 12 SITES IN 4 STATES.** (Esterlitz et al, 1989)

| State | # Sites | SL | Avg TS | % > 70 |
|---|---|---|---|---|
| AZ | 3 | Trk: 65<br>PV: 65 | Trk: 61.1<br>PV: 66.4 | Trk: 13.8%<br>PV: 26.6% |
| IA | 3 | Trk: 65<br>PV: 65 | Trk: 62.3<br>PV: 65.4 | Trk: 9.0%<br>PV: 16.6% |
| CA | 3 | Trk: 55<br>PV: 65 | Trk: 58.1<br>PV: 63.8 | Trk: 4.0%<br>PV: 20.3% |
| IL | 3 | Trk: 55<br>PV: 65 | Trk: 59.7<br>PV: 65.4 | Trk: 3.2%<br>PV: 18.5% |

**TABLE 2-6: PERCENT OF TRUCKS AND PASSENGER VEHICLES EXCEEDING 65 MPH AND 70 MPH AT 11 SITES IN 3 STATES.** (Freedman and Esterlitz, 1990; data shown collected in June, 1989)

| State | # Sites | SL | Avg TS | % > 65 | % > 70 |
|---|---|---|---|---|---|
| NM | 4 | Trk: 65<br>PV: 65 | Trk: 64.7<br>PV: 66.7 | Trk: 48.5%<br>PV: 66.1% | Trk: 14.0%<br>PV: 23.6% |
| VA | 5 | Trk: 55<br>PV: 65 | Trk: 61.7<br>PV: 66.9 | Trk: 22.4%<br>PV: 69.3% | Trk: 5.1%<br>PV: 25.2% |
| MD | 2 | Trk: 55<br>PV: 55 | Trk: 61.1<br>PV: 61.6 | Trk: 22.3%<br>PV: 27.8% | Trk: 2.3%<br>PV: 6.3% |

IIHS (Status Report, February 3, 1990) cited additional data from nine northeastern states relating to compliance with 55 and 65 mph speed limits on Interstates. Table 2-7 presents these statistics. In all states except Vermont, the percentage of trucks exceeding 70 mph was less than that of passenger vehicles. The difference in the percentage of vehicles exceeding 70 mph was greatest in the five states with uniform 55 mph speed limits and in Ohio, which has a differential (55 truck/65 passenger vehicle) speed limit. Two of the three states with uniform 65 mph speed limits showed significantly smaller percentages of trucks than passenger vehicles exceeding 70 mph.

**TABLE 2-6: PERCENT OF TRUCK AND PASSENGER VEHICLES TRAVELING AT SPEEDS EXCEEDING 70 MPH IN 9 NORTHEASTERN STATES.** (IIHS, 1990)

| State | PSL | % > 70 | State | PSL | % > 70 |
|---|---|---|---|---|---|
| **CT** | Trk: 55<br>PV: 55 | Trk: 1%<br>PV: 14% | OH | Trk: 55<br>PV: 65 | Trk: 4%<br>PV: 27% |
| **MA** | Trk: 55<br>PV: 55 | Trk: 4%<br>PV: 13% | **NH** | Trk: 65<br>PV: 65 | Trk: 15%<br>PV: 32% |
| **NY** | Trk: 5.5<br>PV: 55 | Trk: 3%<br>PV: 9% | VT | Trk: 65<br>PV: 65 | Trk: 25%<br>PV: 23% |
| **NJ** | Trk: 55<br>PV: 55 | Trk: 1%<br>PV: 8% | WV | Trk: 65<br>PV: 65 | Trk: 10%<br>PV: 19% |
| ***PA*** | Trk: 55<br>PV: 55 | Trk: 4%<br>PV: 10% | | | |

## 2.3 Motor Carrier Safety Survey

Beilock (1989) conducted 1,285 interviews with long-haul truck drivers of tractor trailers from Canada and the United States. This survey, conducted in conjunction with the Regular Common Carrier Conference, addressed two principal issues relevant to the current study:

- Highway cruising speeds (perceived speeds of commercial trucks; not necessarily the average cruising speed of the respondent)

- Acceptance and use of monitoring devices such as onboard computers, tachographs, and radar detectors (addressed in Chapter 4).

Interviewed drivers reported the perception that the 65 mph speed limit was exceeded by trucks less frequently than was the 55 mph speed limit. The average estimated cruising speed of commercial trucks (as perceived by drivers) was 60 mph on 55 mph highways and 67 mph on 65 mph highways. These averages were nearly identical to those reported in 1988.

These survey results are based on drivers' perceptions of the prevailing speeds of commercial trucks, not on actual measurements. Obviously, these results should be interpreted with caution. However, the RCCC survey results are generally consistent with the observational studies of truck speeds cited earlier in this chapter.

## 2.4 Summary and Conclusions

This chapter reviewed studies of the highway travel speeds of trucks and other vehicles. The following major conclusions can be drawn:

- Studies of highway travel speeds that employ conventional radar systems are likely to underestimate vehicle travel speeds, since a significant percentage of vehicles are equipped with radar detectors. Of all vehicle types, heavy trucks are apparently most likely to have radar detectors; thus, radar statistics are likely to be least valid for heavy trucks.

- Highway speed limit compliance for both combination trucks and other vehicle types is, in general, poor. For example, on most 55 mph highways a ***majority*** of both trucks and passenger vehicles exceed the speed limit. However, few trucks exceed the speed limit grossly; e.g., on 55 mph highways the percentage of trucks traveling at >65 mph generally varies between 5 and 20 percent.

- At highway locations where there are uniform speed limits for trucks and passenger vehicles (i.e., both 55 mph or both 65 mph), heavy trucks generally travel at lower average speeds and exceed the speed limit less frequently than do passenger vehicles. At speeds grossly above the speed limit (e.g., >70 mph on a 55 mph highway), the truck percentage is even lower relative to the passenger vehicle percentage. These conclusions are based on numerous studies employing ***nondetectable*** radar at multiple locations across the United States.

- Generally, the amount of variance among trucks in highway travel speeds appears to be less than that of passenger vehicles. Considering both 55 mph and 65 mph highways, one finds that the highway travel speeds of trucks are predominantly in a relatively narrow band between 55 mph and 68 mph. Truck compliance with 55 mph speed limits on Interstates is poor, particularly when the speed limit for other vehicles is 65 mph.

- The incidence of speeds exceeding 70 mph (a hypothetical level at which speed-limiting devices might be set) is lower for trucks than for passenger vehicles. On highways with uniform truck/car 55 mph speed limits, the studies cited indicate that an average of approximately 3 percent of trucks and 10 percent of passenger vehicles exceed 70 mph. On uniform 65 mph highways, an average of approximately 14 percent of trucks and 23 percent of passenger vehicles exceed 70 mph. There was considerable variation around all of these means; i.e., large differences in the incidence of high-speed driving at different highway locations.

# 3.0 STATISTICS ON HEAVY TRUCK SPEEDING-RELATED CRASHES

This chapter presents statistics relating to the question of how truck speeding contributes to the overall truck crash picture. The emphasis is on crashes occurring at speeds in excess of 65 mph or 70 mph, since these would be the key targets of speed-limiting devices. Data have been accessed from four state accident databases and one national accident database, the Fatal Accident Reporting System (FARS). These databases all differentiate combination-unit trucks from other vehicles, and contain the coded variables ‘“roadway posted speed limit” (PSL) and “vehicle travel speed” (TS). These two variables, in combination, provide the basis for assessing the truck speeding issue, particularly the question of potential benefits from the use of devices that limit maximum vehicle speed. Another national database, the General Estimates System (GES), has been used to provide baseline total national crash involvement estimates.

The data presented in this chapter represent vehicle involvements in police-reported traffic crashes where the variables “vehicle travel speed” and “posted speed limit” were coded. A vehicle was considered to be speeding if its estimated travel speed exceeded the posted speed limit. Estimated speeds are coded on Police Accident Reports (PARs) by investigating police officers based on their post-crash investigations rather than direct observation of vehicle speed. Vehicle inspection, scene inspection, and interviews with drivers and witnesses are the key methods for making this determination. Since there must be some clear indication of speeding before the officer will code it, the incidence of speeding is likely underreported in accident databases. However, there is no known trend toward ***differential*** underreporting of speeding involvement for different vehicles types. Therefore, the assumption is made here that these statistics accurately portray ***relative*** speeding involvement for different vehicle types.

The PAR-reported travel speed statistics are probably more valid than other coded PAR variables that might be used to attempt to isolate speeding involvement in crashes. For example, the data attribute “Violation: Speeding” is likely to understate actual speeding even more seriously, since the investigating officer must have clear physical or eyewitness evidence before the speeding violation is charged (and thus coded on the PAR). For example, in 1988-89 combined, there were only nine FARS cases in which a fatal crash-involved combination-unit truck traveling on a 65 mph highway was charged with a speeding violation. There were only 44 such cases for passenger vehicles. These counts likely understate actual high-speed involvement by a significant degree. Therefore, statistics on speeding violations are not considered to be valid indicators of actual speeding involvement.

Note also that all statistics reported in this chapter are based on counts of crash-involved vehicles, as opposed to counts of crashes. Thus, a two-vehicle crash involving a truck and a nontruck would contribute one “involvement” in each category. Comparative statistics are provided for combination-unit trucks, single-unit trucks, and “passenger vehicles,” although the latter category here contains all motor vehicles ***other*** than combination-unit and single-unit trucks. Approximately 97 percent of the “passenger vehicle” category consists of automobiles and light trucks/vans, with the remainder being motorcycles, buses, and other miscellaneous vehicles.

The most important caveat relating to all of the speeding-related crash statistics cited in this chapter is that the categorization "speeding-related" or "high-speed related" does not necessarily assure that speeding was the ***primary cause*** of the crash. Virtually all crashes involve multiple contributing factors. The elimination of any one factor may or may not prevent the crash. High-speed crashes typically involve some other driver error (e.g., following too closely, improper lane change) that precipitates the crash. Eliminating the high-speed element may, or may not, prevent the crash. Thus, the speeding-related and high-speed-related crashes identified in this chapter should actually be viewed as ***potential*** target crashes for speed control devices. The actual effectiveness of such devices in preventing and/or reducing the severity of these potential target crashes is unknown.

## 3.1 Selected State Statistics

This section presents state data based on police-reported crashes for four selected states: Florida, Georgia, Ohio, and Virginia. All of these code the crash variables "vehicle travel speed" and "posted speed limit." The speeding involvement statistics quoted for these states should be interpreted with caution. In addition to the general underreporting factor described above, missing data rates are generally high for the vehicle travel speed variable. In the four state files examined, the missing data rates for combination-unit trucks varied from 5 percent in Virginia to 29 percent in Georgia. Passenger vehicle missing data rates for travel speed were higher in all four of these states, suggesting possible differential accuracy of the coding for combination-unit trucks versus passenger vehicles. However, the direction or significance of the differential accuracy (if any) is not known.

The statistics for all four states are for time periods after speed limits were raised to **65** mph on rural Interstates. Two of the states (Florida and Georgia) implemented the rural Interstate **65** mph speed limit uniformly for all vehicles including trucks. Ohio and Virginia implemented differential speed limits on rural Interstates. Thus, only Florida and Georgia can be used for a direct comparison between trucks and nontrucks at a PSL of 65 mph.

This chapter presents a summary of the state statistics, aggregated across states by maximum speed limit for trucks. Statistics for Florida and Georgia are aggregated, since, as noted above, both of these states have 65 mph speed limits for all vehicles on rural Interstates. Statistics for Ohio and Virginia are similarly aggregated, since these two states use the same differential speed limit system for trucks and passenger vehicles. The statistics shown in this section are also aggregated across PSLs from 35 mph to 65 mph in order to capture high-speed driving on all roadways where it is likely to occur. Vehicles for which TS or PSL were coded as "missing" or "unknown" are not included in the present statistics.

### 3.1.1 States With 65 mph Maximum Speed Limits for Trucks and Passenger Vehicles (Florida and Georgia)

**Table 3-1** presents travel speed statistics for crash-involved vehicles from two states (Florida and Georgia) with 65 mph maximum speed limits for trucks and passenger vehicles. The Florida statistics are for the time period April 27 to December 31, 1987. The Georgia statistics are for the time period February 19 to December 31, 1988. The percentages shown are ***unweighted*** means of the two states. The percentage of vehicles for four levels of speeding are presented (note: > symbol used for "greater than"): speeding (TS > PSL), speeding > 65 mph, speeding > 70 mph, and speeding > 75 mph. Note that these categories of speeding are not mutually exclusive; e.g., the "speeding" category includes all vehicle travel speeds above the posted speed limit. The statistics relating to vehicles exceeding 70 mph are perhaps most relevant to the issue of mandated speed-limiting devices, since speed-limiting devices might be set at a value near 70 mph. Note also that on-grade crashes are included in the present state percentages, since not all of the state files accessed included "roadway profile" as a variable.

**Table 3-1** shows that crash-involved passenger vehicles have the highest speeding percentages at all levels. In general, single-unit trucks have the lowest percentages for speed involvement. Note also that the combination-unit truck speeding percentage decreases at higher speeds, not only in terms of absolute percentage, but also in relation to the passenger vehicle percentage.

**Table 3-l: TS vs. PSL for Three Vehicle Types, Florida + Georgia.** Comparison of estimated vehicle travel speeds with posted speed limits for combination-unit trucks, single-unit trucks, and passenger vehicles involved in crashes. All percentages are unweighted means of the two state samples.

| **Statistic** **Vehicle Type:** | **Comb-Unit Trucks** | **Sngl-Unit Trucks** | **Pass. Vehicles** |
|---|---|---|---|
| **Number of Crash-Involved Vehicles (w/ TS & PSL known)** | FL: 3,064<br>GA: 5,293 | FL: 3,745<br>GA: 4,887 | FL: 157,680<br>GA: 178,034 |
| **Percent Legal Speed (TS $\leq$ PSL)** | 95.53% | 96.39% | 93.78% |
| **Percent Speeding (TS > PSL)** | 4.47% | 3.62% | 6.23% |
| **Percent Speeding > 65 mph** | 0.51% | 0.21% | 0.89% |
| **Percent Speeding > 70 mph** | 0.14% | 0.14% | 0.46% |
| **Percent Speeding > 75 mph** | 0.06% | 0.07% | 0.30% |

### 3.1.2 States With Differential Maximum Speed Liiits for Trucks and Passenger Vehicles (Ohio and Virginia)

**Table 3-2** presents travel speed statistics for crash-involved vehicles from two states (Ohio and Virginia) with differential maximum speed limits for trucks (55 mph) and passenger vehicles (65 mph). The Ohio statistics are from the time period January 1 to September 30, 1988. The Virginia statistics are for the time period July 1 to December 31, 1988. The percentages shown. ***are unweighted*** means of the two states, except that only Virginia statistics are used for the >70 mph category, since Ohio does not code travel speeds to this level of detail. The data in **Table 3-2 are** arrayed as in **Table 3-1.**

Crash-involved single-unit trucks have lower percentages of all levels of speeding involvement than do the other vehicle types. Crash-involved combination trucks have a slightly higher speeding percentage (5.60 percent) than do passenger vehicles (4.92 percent). However, the percentages of crash-involved vehicles exceeding 65 mph, 70 mph, and 75 mph are lower for combination trucks than for passenger vehicles.

Recall from Chapter 2 (e.g., **Tables 2-2, 2-3, 2-5, 2-6**) that trucks are more likely to exceed the speed limit on 55 mph highways than on 65 mph highways, particularly when passenger vehicles are permitted to travel at 65 mph. The finding that a larger percentage of accident-involved combination trucks than passenger vehicles in Ohio and Virginia were speeding is consistent with the Chapter 2 findings.

**Table 3-2: TS vs. PSE for Three Vehicle Types, Ohio + Virginia.** Comparison of estimated vehicle travel speeds with posted speed limits for combination-unit trucks, single-unit trucks, and passenger vehicles involved in crashes. All percentages are unweighted means of the two state samples.

| Statistic Vehicle Type: | Comb-Unit Trucks | Sngl-Unit Trucks | Pass. Vehicles |
|---|---|---|---|
| Number of Crash-Involved Vehicles (w/ TS & PSL known) | OH: 7,460<br>VA: 1,639 | OH: 4,969<br>VA: 3,644 | OH: 204,377<br>VA: 85.001 |
| Percent Legal Speed (TS ≤ PSL) | 94.41% | 97.51% | 95.09% |
| Percent Speeding (TS > PSL) | 5.60% | 2.49% | 4.92% |
| Percent Speeding > 65 mph | 0.48% | 0.14% | 0.69% |
| Percent Speeding > 70 mph (Based on Virginia only; Ohio does not code) | 0.18% | 0.13% | 0.48% |
| Percent Speeding > 75 mph | 0.10% | 0.04% | 0.23% |

## 3.2 Fatal Accident Reporting System (FARS) Statistics

The Fatal Accident Reporting System (FARS) is a national census of all fatal traffic crashes. FARS is based primarily on PAR data. Like the four state databases in Section 3.1, FARS includes the variables of vehicle travel speed (TS) and posted speed limit (PSL). The FARS statistics presented here **(Table 3-3)** are limited to those 1988 and 89 fatal crash involvements for which both TS and PSL were known. This represents 42 percent of the FARS cases for these two years. To isolate target crashes, the FARS "Roadway Profile" variable was used to eliminate on-grade crashes occurring at speeds greater than 65 mph. This is based on the presumption that such high speed crashes occurring on a grade were likely downhill crashes where speed-limiting devices would not likely have affected vehicle speed.

Both fatal-accident-involved combination-unit trucks and single-unit trucks have considerably lower speeding percentages than do passenger vehicles in all four categories: speeding, speeding > 65 mph, speeding > 70 mph, and speeding > 75 mph. Section 3.3 (below) presents annual fatal crash involvement national problem estimates based on these statistics regarding target crash involvements at various travel speeds.

**Table 3-3: TS vs. PSL for Three Vehicle Types Involved in Fatal Crashes.** Percentage of fatal crash involvements (with TS and PSL known) involving speeding at various levels for combination-unit trucks, single-unit trucks, and passenger vehicles (raw counts, 1988-89 two-year total, FARS). Percentages for > 65 mph, > 70 mph, and > 75 mph crash involvements are based on not-on-grade crashes only.

| Statistic Vehicle Type: | Comb-Unit Trucks | Sngl-Unit Trucks | Pass. Vehicles |
|---|---|---|---|
| Fatal-Crash-Involved Vehicles (TS & PSL Known) | 3,906 | 808 | 47,058 |
| Percent Legal Speed (TS ≤ PSL) | 87.1% | 88.6% | 65.9% |
| Percent Speeding (TS > PSL) | 12.9% | 11.4% | 34.1% |
| Percent > 65 mph, Non-Grade | 1.7% | 1.0% | 9.6% |
| Percent > 70 mph, Non-Grade | 0.7% | 0.6% | 6.3% |
| Percent > 75 mph, Non-Grade | 0.2% | 0.4% | 4.4% |

## 3.3 Problem Size Estimates: Speed-Monitoring and Speed-Limiting Target Crash Involvements

This section presents problem size estimates for the "target" crashes of speed monitoring and speed-limiting devices. The statistics on speeding-related crashes presented in Sections. 3.1 and 3.2 can be used to estimate the number of speed-monitoring device and speed-limiting device target crashes, and to derive target crash involvement rates (i.e., involvements per 100 million vehicle miles traveled) and likelihoods (i.e., number of annual' involvements per 1,000 vehicles). These statistics provide additional insights into the extent of involvement of combination-unit trucks (and other vehicles) in speeding-related crashes. Three levels of speeding are assessed: all speeding (TS > PSL), speeding in excess of 65 mph, and speeding in excess of 70 mph. Speed-monitoring devices could potentially be used as a countermeasure against all of these categories (if the posted speed limits of the roadways traveled were known), whereas speed-limiting devices would only target crashes above their maximum speed set point (e.g., 70 mph).

Section 3.3.1 addresses speeding-related crashes (TS >PSL). Section 3.3.2 addresses crashes involving travel speeds exceeding 65 mph, the national maximum legal speed. Section 3.3.3 addresses crashes involving travel speeds greater than 70 mph. Speed-limiting devices, if mandated, might be set at some value slightly higher than 65 mph to permit some tolerance for additional power needed for hill-climbing or passing. Thus the selection here of 70 mph as a travel speed value for analysis.

### 3.3.1 Problem Size Estimates: Speeding-Related Crashes

Speeding-related crashes (i.e., speeding at any posted speed limit) might represent those targeted by the use of speed monitoring devices, with the caveat that the applicability of speed monitors to crashes at posted speed limits of less than 55 mph is questionable. Measures of problem size include involvement rate (i.e., involvements per 100 million vehicle miles traveled) and number of annual involvements per 1,000 vehicles. The analysis is based on police-reported speed involvement in crashes, supplemented by statistics on vehicle miles traveled (VMT) and vehicle registration counts.

**Tables 3-4** and **3-5** present these statistics for three vehicle types (combination-unit trucks, single-unit trucks, and passenger vehicles) for speeding-related crashes. The tables are based on 1988-89 GES and FARS, annual VMT estimates (FHWA), and vehicle registrations (FHWA). Table 3-4 presents the statistics for all crashes (using average 1988-89 GES crash estimates). The percentages used for speeding-related vehicle involvements in crashes are the unweighted mean of the four states reported here (Florida, Georgia, Ohio, and Virginia). **Table 3-5** presents statistics for fatal crashes, based on 1988-89 FARS data. As was noted in Section 3.1, speeding is thought to be underreported on PARS, although there is no known trend toward ***differential*** underreporting of speeding of different vehicle types. Therefore, the assumption is made here that the statistics presented in

Tables 3-4 and 3-5 are generally accurate in terms of the ***relative*** involvements of different vehicle types.

The data on speeding-related crashes indicate that, by all measures, single-unit trucks are significantly underinvolved in speeding-related crashes relative to other vehicle types. This is true both for all speeding-related crashes (Table 3-A) and fatal crashes (Table 3-5). As compared to passenger vehicles, combination-unit trucks have lower percentages of crash involvements and fatal crash involvements where speeding is indicated, and far lower rates of speeding-related crashes per 100 million vehicle miles traveled (VMT). However, their annual likelihoods of involvement (per 1,000 vehicles) in speeding-related crashes and fatal crashes are greater for combination-unit trucks than for other vehicle types due to their high exposure (annual mileage per vehicle).

The absolute size of the truck speeding-related crash problem is small in relation to that of all vehicle types combined. The combined number of speeding-related crash involvements for combination-unit trucks and single-unit trucks (14,300) is only about 2 percent of the total for all vehicle types (approximately 652,000).

**Table 3-4: Problem Size Estimates: Speeding-Related Crashes for Three Vehicle Types Based on Indications of Speeding on PARs.**

| Statistic — Vehicle Type: | Comb-Unit Trks | Sngl-Unit Trks | Pass. Vehs. |
|---|---|---|---|
| Annual Vehicle Involvements in Crashes (1988-$9 Average, GES) | 220,000 | 122,000 | 11,440,000 |
| Percent Speeding-Related (Unweighted Mean: FL, GA, VA, & OH) | 5.03% | 3.05% | 5.57% |
| Estimated Annual Number Speeding-Related Vehicle Involvements in Crashes | 10,200 | 4,100 | 638,000 |
| Annual VMT (Millions; FIIWA) | 90,149 | 51,231 | 1,884,207 |
| Involvement Rate, Speeding-Related Crashes (Per 100 M VMT) | 11.3 | 7.9 | 33.8 |
| Vehicle Registrations (FI-IWA) | 1,476,241 | 3,957,319 | 183,547,456 |
| Annual Number Speeding-Related Crash Involvements Per 1,000 Vehicles | 6.9 | 1.0 | 3.5 |

**Table 3-5: Problem Size Estimates: Fatal Speeding-Related Crashes for Three Vehicle Types Based on Indications of Speeding on PARs**

| Statistic — Vehicle Type: | Comb-Unit Trks | Sngl-Unit Trks | Pass. Vehs. |
|---|---|---|---|
| **Annual Vehicle Involvements in Fatal Crashes (1988-89 FARS)** | 4,063 | 1,051 | 56,612 |
| **Percent Speeding-Related** | 12.9% | 11.4% | 34.1% |
| **Estimated Annual Number Speeding-Related Vehicle Involvements in Fatal Crashes** | 520 | 120 | 19,300 |
| Annual VMT (Millions; FHWA) | 90,149 | 51,231 | 1,884,207 |
| Involvement Rate, Speeding-Related Fatal Crashes (Per 100 M VMT) | 0.0058 | 0.0013 | 0.0094 |
| Vehicle Registrations (FHWA) | 1,476,241 | 3,957,319 | 183,547,456 |
| Annual Number Speeding-Related Fatal Crash Involvements Per 1,000 Vehicles | 0.35 | 0.02 | 0.10 |

### 3.3.2 Problem Size Estimates: Speeding > 65 mph-Related Crashes

This section estimates the problem sizes of crashes involving police-reported speeds of greater than 65 mph, the national maximum speed limit. Crashes occurring at speeds in excess of 65 mph could be potential target crashes of both speed-monitoring and speed-limiting devices. The statistics derived are analogous to those derived in Section 3.3.1 above, except that only non-grade crashes are included in the target crash estimates. This reflects the fact that speed-limiting devices would have little effect on downgrade crashes occurring at speeds greater than 65 mph, since most such truck crashes would involve a free-roll situation where road speed governors would not affect vehicle speed.

**Tables** 3-6 presents > 65 mph crash problem size estimates based on national crash involvement estimates (1988-89 GES) and percentage speeding > 65 mph based on two states that record vehicle travel speed, Florida and Georgia. Both Florida and Georgia have uniform 65/65 speed limits on rural Interstates for trucks and cars (as do most states nationally). Using two states with uniform 65/65 rural Interstate speed limits for this analysis helps ensure comparability between vehicle types. To eliminate crashes occurring on downgrades from the problem size estimates, the GES total crash estimates were first modified to omit crash involvements occurring on grades.

Table 3-6: Problem Size Estimates: Speeding > 65 mph-Related Not-on-Grade Crashes for Three Vehicle Types Based on Indications of Speeding on PARs.

| Statistic Vehicle Type: | Comb-Unit Trks | Sngl-Unit Trks | Pass. Vehs. |
|---|---|---|---|
| Annual Vehicle Involvements in Crashes (1988-89 GES) | 220,000 | 122,000 | 11,440,000 |
| Annual Crash Involvements, Not on Grade (1988-89 GES) | 179,000 | 98,000 | 9,731,000 |
| Percent Speeding > 65 mph-Related (Unweighted Mean: FL, GA) | 0.51% | 0.21% | 0.89% |
| Estimated Annual Number Speeding > 65 mph-Related Vehicle Involvements in Crashes | 910 | 200 | 86,600 |
| Annual VMT (Millions; FIIWA) | 90,149 | 51,231 | 1,884,207 |
| Involvement Rate, Speeding > 65 mph-Related Crashes (Per 100 M VMT) | 1.01 | 0.40 | 4.60 |
| Vehicle Registrations (FIIWA) | 1,476,241 | 3,957,319 | 183,547,456 |
| Annual Likelihood; Speeding > 65 mph-Related Crash Involvements Per 1,000 Vehicles | 0.62 | 0.05 | 0.47 |

Table 3-7: Problem Size Estimates: Fatal Speeding > 65 mph-Related Not-on-Grade Crashes for Three Vehicle Types Based on Indications of Speeding on PARs

| Statistic Vehicle Tvoe: | Comb-Unit Trks | Sngl-Unit Trks | Pass. Vehs. |
|---|---|---|---|
| Annual Vehicle Involvements in Fatal Crashes (1988-89 FARS) | 4,063 | 1,051 | 56,612 |
| Percent Speeding > 65 mph-Related | 1.7% | 1.0% | 9.6% |
| Est. Ann. Number Speeding > 65 mph-Related Fatal Crash Involvements (& Fatalities) | 69 (73) | 10 (12) | 5,414 (5,795) |
| Annual VMT (Millions; FIIWA) | 90,149 | 51,231 | 1,884,207 |
| Involvement Rate, Speeding > 65 mph-Related Fatal Crashes (Per 100 M VMT) | 0.08 | 0.02 | 0.29 |
| Vehicle Registrations (FHWA) | 1,476,241 | 3,957,319 | 183,547,456 |
| Annual Likelihood; Speeding > 65 mph-Related Fatal Crash Involvements Per 1,000 Vehicles | 0.047 | 0.003 | 0.029 |

**Table 3-7** presents speeding > 65 mph fatal crash involvement problem size estimates based on 1988-89 FARS statistics. FARS cases with unknown TS and/or PSL values were distributed proportionately to those with known values in order to generate national estimates of speeding > 65 mph-related fatal crash involvements.

The statistics on speeding > 65 mph crashes and fatal crashes indicate that, as for speeding-related crashes, single-unit trucks have the lowest levels of involvement regardless of the statistical metric used. Combination-unit trucks have lower percentages and rates of crash involvements and fatal crash involvements where speeding > 65 mph is indicated than do passenger vehicles. However, as previously, their annual likelihoods of involvement (per 1,000 vehicles) in speeding > 65 mph-related crashes and fatal crashes are greater than other vehicle types due to their high exposure (annual mileage per vehicle).

### 3.3.3 Problem Size Estimates: Speeding > 70 mph-Related Crashes

**Tables** 3-8 and 3-9 present statistics on the problem sizes of crashes involving police-reported speeds of greater than 70 mph. This group of crashes was selected as a statistically-convenient approximation of the crashes targeted by speed-limiting devices. If legally-mandated, speed-limiting devices might be set at or near 70 mph. The statistics derived are analogous to those derived in Section 3.3.2 above.

Problem size estimates of speeding > 70 mph crashes are based on national crash involvement estimates (1988-89 GES) and percentage speeding > 70 mph based on Florida and Georgia statistics. Speeding>70 mph-related statistics for Virginia were very similar to those for Florida and Georgia; however, Virginia was not included because it has a differential 65/55 speed limit for cars and trucks on rural Interstates. The speeding>70 mph fatal crash involvement problem size estimates are based on 1988-89 FARS statistics.

The statistics on all speeding > 70 mph crashes and on such fatal crashes indicate, as previously, that single-unit trucks have the lowest levels of involvement regardless of the statistical metric used. Combination-unit trucks have much lower percentages and rates of crash involvements and fatal crash involvements where speeding > 70 mph is indicated than do passenger vehicles. Their annual likelihood of involvement (per 1,000 vehicles) in all speeding > 70 mph-related crashes is less than that of passenger vehicles, whereas their likelihood of involvement in a target fatal crash is approximately equal to that of passenger vehicles.

To the extent that these data on police-reported speeding > 70 mph-related crashes and fatal crashes accurately represent the potential target problem size of speed-limiting devices for combination-unit trucks, that problem size must be regarded as small within the greater context of truck safety and overall traffic safety. Combination-unit truck speeding > 70 mph-related involvements represent only about 1 of every 800 combination-unit truck involvements at all

**Table 3-8: Problem Size Estimates: Speeding >70 mph-Related Not-on-Grade Crashes for Three Vehicle Types Based on Indications of Speeding on PARs.**

| Statistic — Vehicle Type: | Comb-Unit Trks | Sngl-Unit Trks | Pass. Vehs. |
|---|---|---|---|
| Annual Vehicle Involvements in Crashes (1988-89 GES) | 220,000 | 122,000 | 11,440,000 |
| Annual Crash Involvements, Not on Grade (1988-89 GES) | 179,000 | 98,000 | 9,731,000 |
| Percent Speeding > 70 mph-Related (Unweighted Mean: FL, GA) | 0.15% | 0.14% | 0.47% |
| Estimated Annual Number Speeding > 70 mph-Related Vehicle Involvements in Crashes | 270 | 140 | 45,700 |
| Annual VMT (Millions; FHWA) | 90,149 | 51,231 | 1,884,207 |
| Involvement Rate, Speeding > 70 mph-Related Crashes (Per 100 M VMT) | 0.32 | 0.27 | 2.43 |
| Vehicle Registrations (FHWA) | 1,476,241 | 3,957,319 | 183,547,456 |
| Annual Likelihood; Speeding > 70 mph-Related Crash Involvements Per 1,000 Vehicles | 0.19 | 0.03 | 0.25 |

**Table 3-9: Problem Size Estimates: Fatal Speeding > 70 mph-Related Not-on-Grade Crashes for Three Vehicle Types Based on Indications of Speeding on PARs**

| Statistic — Vehicle Type: | Comb-Unit Trks | Sngl-Unit Trks | Pass. Vehs. |
|---|---|---|---|
| Annual Vehicle Involvements in Fatal Crashes (1988-89 FARS) | 4,063 | 1,051 | 56,612 |
| Percent Speeding > 70 mph-Related | 0.7% | 0.7% | 6.3% |
| Estimated Annual Number Speeding > 70 mph-Related Fatal Crash Involvements | 30 | 7 | 3,577 |
| Annual VMT (Millions; FHWA) | 90,149 | 51,231 | 1,884,207 |
| Involvement Rate, Speeding > 70 mph-Related Fatal Crashes (Per 100 M VMT) | 0.03 | 0.01 | 0.19 |
| Vehicle Registrations (FHWA) | 1,476,241 | 3,9.57,319 | 183,547,456 |
| Annual Likelihood; Speeding > 70 mph-Related Fatal Crash Involvements Per 1,000 Vehicles | 0.020 | 0.002 | 0.019 |

speeds, and only about 1 of every 170 speeding > 70 mph-related crash involvements of all vehicle types combined. Problem size estimates of speeding > 70 mph fatal crash involvements (based on the data in Table 3-9) are shown graphically in Figure 3-1.

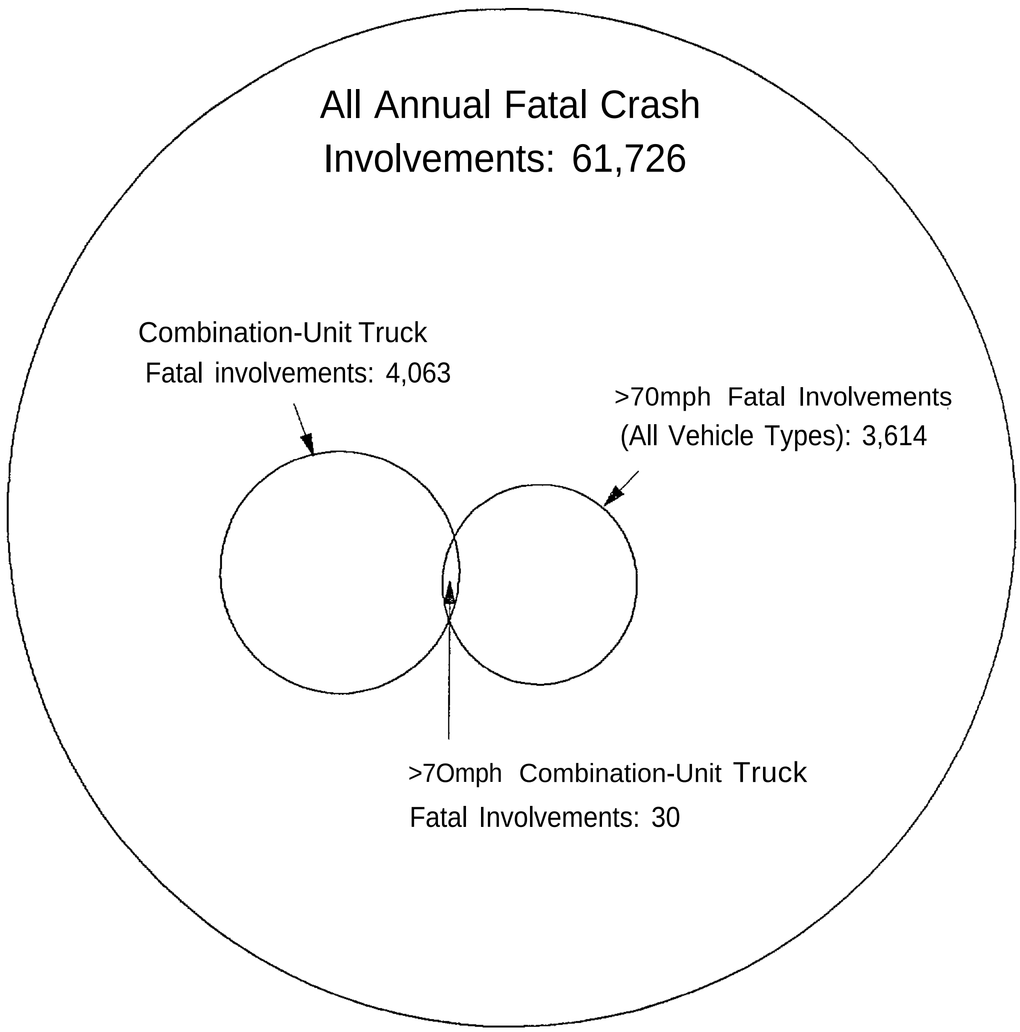


**Figure 3-l: Venn diagram showing the relative problem sizes of speeding > 70 mph-related combination-unit fatal crash involvements in relation to relevant larger segments of the annual national fatal crash experience.** Annual average of 1988-89 FARS statistics which, in turn, are based on PAR data; >70 mph-related crashes are not-on-grade crashes.

## 3.4 Summary of Available Crash Statistics

Based on the statistics presented in this chapter, the following summary statements may be made regarding contribution of speeding (and, in particular, speeding at high speeds) to the heavy truck crash picture:

- The state PAR statistics providing the basis for this analysis probably underestimate the true involvement of speeding and speeding> 65 mph in crashes since speeding is likely to be undercoded on PARS. However, the magnitude of this bias is not known to be different for trucks and passenger vehicles. For the purpose of this analysis, the underreporting bias is presumed to be equal for trucks and other vehicle types. To the extent that this assumption is true, these statistics can be used to compare the relative contributions of speeding to the crash involvements of different vehicle types.

- Although PAR statistics may understate the true speeding involvement in crashes, the categorization "speeding-related" or "high-speed related' does not necessarily assure that speeding was the ***primary cause*** of the crash. Virtually all crashes involve multiple contributing factors. Eliminating the high-speed element may, or may not, prevent the crash. Thus, the speeding-related and high-speed-related crashes identified in this chapter should actually be viewed as ***potential*** target crashes for speed control devices, not as the actual number of crashes that would be prevented by universal use of these devices.

- Virtually every speed involvement statistic from every available source indicates that ***single-unit*** trucks have a low involvement in speeding-related and speeding > 65 mph-related crashes and fatal crashes compared to other vehicle types. For example, the annual probability that a single-unit truck will be involved in a fatal crash involving speeding>65 mph (indicated on the PAR) is approximately 1 in 400,000. Single-unit trucks are involved in fatal speeding> 65 mph crashes at the rate of only about 1 per 5 ***billion*** miles. Even allowing for considerable underreporting of speeding involvement on PARs, these are impressive motor vehicle safety statistics.

- The percentage of crash-involved vehicles coded as speeding (TS >PSL) is generally lower for combination-unit trucks than for passengers vehicles. An exception was noted in the Ohio/Virginia data representing states with lower rural Interstate speed limits for trucks than for passenger vehicles.

- Available statistics indicate that speeding > 65 mph occurs at a lower percentage among crash-involved and fatal-crash-involved combination-unit trucks than passenger vehicles. The disparity between these vehicle types increases with increasing travel speeds (e.g., >70 mph).

- Compared to passenger vehicles, combination-unit trucks have consistently lower speeding-related crash involvement rates per 100 million vehicle miles traveled. However, because of their high exposure (i.e., highway mileage driven per year), combination-unit trucks have greater probabilities of involvement than do passenger vehicles in speeding > 65 mph-related crashes during a given time period (e.g., a year), and similar probabilities of involvement in speeding>70 mph-related crashes.

- The estimated absolute numbers of crashes and fatal crashes involving truck speeding and speeding in excess of 65 mph (or in excess of 70 mph) are small, particularly when viewed in the context of the overall truck crash picture (e.g., all truck crash involvements) or in the context of the overall ***speeding*** safety problem when all vehicle types are considered. For example, there are an estimated 30 fatal crash involvements (resulting in 39 fatalities) annually involving combination-unit trucks speeding in excess of 70 mph. This represents only 1 of every 135 combination-unit truck fatal crash involvements at all speeds, and only about 1 of every 120 speeding > 70 mph-related crash involvements of all vehicle types combined.

# 4.0 SPEED CONTROL MECHANISMS AND DEVICES

This chapter presents information on available engine mechanisms and other devices that monitor and/or limit truck speed. This includes the following types of equipment:

- Devices (usually retrofit but may be OEM-installed) that monitor truck speed:
  - On-board computers (recorders)
  - Tachographs

- Mechanisms built into the engine that limit engine revolutions per minute (RPM) and thus have the effect of limiting truck speed (engine speed governors).

- Supplemental devices that control truck speed:
  - Vehicle speed governors
  - Cruise controls

This chapter focuses on the mechanisms and devices themselves; i.e., their functions, operation, and cost. The next chapter (Chapter 5.0) will address practical applications of the devices by trucking fleets.

## 4.1 Study Methodology

Manufacturers of truck engines and devices used in controlling truck speed were contacted. Telephone discussions were conducted and/or available written product information was obtained from the following manufacturers, vendors, and industry associations:

- American Trucking Associations, Inc.
- Argo Instruments Inc.
- Caterpillar, Inc.
- CADEC Systems, Inc.
- Detroit Diesel Corporation
- Dynalco Controls (formerly TRW Transportation Electronics).
- Mack Trucks
- Motor Vehicle Manufacturers Association, Inc.
- Rockwell International Corporation
- Stemco Manufacturing Company
- Volvo GM Heavy Truck

Discussions with representatives of the above organizations provided general information on available technology and its uses. General information was obtained from each source on such issues as device functioning, operation, output (whether control or monitoring information), market penetration, cost, vulnerability to tampering, and implementation considerations.

## 4.2 Liiitations of Speed Control Devices

Before addressing specific mechanisms and devices, it is worthwhile to briefly review some limitations that are inherent in any attempt to limit vehicle speed by mechanical or electronic means.

**Downhill Speeds** No available "speed control" device can limit truck speed on downgrades. A truck can achieve a substantial free roll on a downgrade of as little as 2 percent. The parasitic drag (drag caused by tire rolling resistance, aerodynamic drag, and engine braking) for a loaded tractor-trailer is much less, relative to its weight, than is the parasitic drag on a passenger vehicle. In a downgrade free roll situation, all speed controls except braking are overridden. The free roll situation requires much greater braking power to prevent excessive downhill speeds. No speed-limiting devices obviate the need for effective braking systems or prevent drivers from traveling at high speeds on downgrades. Speed-limiting devices have little potential effect on runaway accidents or other speed-related accidents on downgrades, although they may prevent some accidents by limiting the possible initial speeds at the start of the downgrade. Thus, on downgrades drivers control their own speeds through braking and other devices (e.g., retarders) that assist braking.

On the positive side, it should be noted that speed monitoring devices do record downhill speeds, thus providing after-the-fact evidence of any excessive truck speed.

**Importance of Gear Ratios** Engine speed is translated into forward vehicle speed through the drivetrain/transmission, the rear axle and tires. Transmission ratio, rear axle ratio, and tire size are all factors that influence vehicle travel speeds resulting from particular engine speeds. Depending on the gear ratio settings, this may make vehicle speed limitation easier or more difficult.

By choosing certain combinations of transmission top gear ratio, rear axle ratio, and tire size, in conjunction with top engine speed, maximum vehicle speed can be limited. By itself, this approach is an inefficient way to control vehicle speed, however. The problem with using gear binding as the sole method for limiting road speed is that the top engine rpm is typically not the most efficient engine speed. Thus, while this approach does limit the top speed of the vehicle, it also prevents maximum fuel efficiency from being achieved.

**Tampering** No device is tamper proof. Nevertheless, most available devices are tamper-resistant, generally because tampering is evident to fleet maintenance personnel or others inspecting the vehicle engine. For example, newer electronically-controlled engines can detect when their sensors are not operating properly. Another feature implemented to deter tampering is the use of sophisticated, encrypted software programs to control the sensing devices. A determined truck operator or mechanic can, however, defeat almost any speed control device if so motivated.

**Need for Managemeut Involvement**

Without the active involvement of fleet management, the effectiveness of almost any mechanical or electronic approach to speed limitation is likely to yield disappointing results. Management needs to be actively involved in such activities as the selection of engine/drivetrain specifications that will limit maximum truck speeds to desired levels, review of vehicle speed records, and the establishment and management of driver incentives for speed compliance. In their 1982 review of commercial speed control concepts, Weiss et al emphasized that "management commitment is the most important factor affecting the use of a speed control concept or strategy." For each mechanical and electronic approach to speed limitation, it is important to consider how the approach might be implemented by fleet management. Fleet management issues are addressed principally in Chapter 5.

**Possible Negative Consequences of Speed Control**

In part, driver resistance to speed control is based on the widespread view that limiting top vehicle speed (however that limitation is accomplished) has certain negative consequences ("disbenefits"). Weiss et al (1982) listed two principal objections relating to safety: 1) loss of passing power, which many drivers say they need to pass safely; 2) loss of extra power needed during unspecified emergency situations where a period of high speed is required to avoid a crash threat. The safety implications of these reputed safety disbenefits cannot be easily assessed, although these considerations need to be weighed against the potential advantages of truck speed limitation.

## 4.3 Speed Monitoring Devices

Speed monitoring devices are passive systems; that is, they record rather than control vehicle speed. The potential speed-limiting effects of speed monitors are indirect (e.g., requiring follow-up management action) but are, under some circumstances, broader than those of speed controls. That is, monitors may potentially be used to enforce fleet speed compliance on both 65 mph and 55 mph highways. Two common types of monitoring devices are on-board computers and tachographs.

### 4.3.1 On-Board Computers

On-board computers or recorders are becoming more prevalent in the trucking industry. This technology has been in use in heavy trucks for over a decade, and is continually being upgraded by hardware and software improvements.

Available on-board computers typically include hardware, customized software for the client, and peripherals for ease in downloading and analyzing the data. Some manufacturers sell cruise. controls and on-board computers together as a package, thereby giving drivers the ability to better control their cruising speeds, and fleets the means to monitor driver performance.

**Mechanism** On-board computers are wired to the engine, speedometer, and odometer so that vehicle speed, engine RPMs and idle time may be monitored. The computer itself typically is mounted in the luggage compartment or behind the seat in the cab.

**Operation** Most recording systems have display or indicator panels. A variety of key pads are available for driver input (e.g., log-in, data requests).

Data may be retrieved from a cartridge or through an electronic hook-up at the terminal. Accessible data include trip start and stop times, speed, rpm, mpg, and engine idling. Various standard reports may be printed out including: driver's performance reports, driver summary reports, and Department of Transportation hours-of-service logs. The reports vary depending on the fleet's needs and the software used. Data conversion programs are available which allow the data to be converted to ASCII files or commercial spreadsheet software format for further analysis.

**Market Penetration** Industry sources estimate that more than 100,000 units are presently in use. A large majority of these are installed on truck tractors (of which there are approximately 1.5 million in the United States). Thus, approximately 5-7 percent of tractors are already equipped with on-board computers. Device manufacturers expect their use to increase in the future, in part because these units can be tailored to the specific needs of the fleet.

**Cost** Unit cost is $700-$1895, with the higher costs for more sophisticated equipment offering special features. Additional factors that affect cost include operations and maintenance training for both drivers and management personnel.

**Tampering** The plastic material that houses the computer is extremely resistent to damage. One manufacturer reported that its data cartridges had been set on fire and that trucks had run over them without destroying the data. In the event that the connecting wires are cut, a power loss is recorded and a back-up battery begins to operate.

**Management Approaches**

For on-board computers to be effective against speeding, manufacturers say that company standards need to be implemented and that managers need to actively manage their fleets based on the speed data. They recommend that fleet management programs include positive incentives for speed compliance, as well as sanctions such as reprimands and disciplinary action for noncompliance with speed limits or for tampering.

Additionally, manufacturers recommend that managers downplay the "tattletale box" image of the recorders when they introduce them into their fleets. Manufacturers recommend that managers present positive ways that recorders can assist drivers, with emphasis on the amount of information that the on-board computers can provide efficiently to both drivers and to fleet management.

As noted above, manufacturers strongly recommend incentive programs with cash bonuses or other rewards for drivers who demonstrate good performance through reduced speeds, low fuel usage, and/or no speeding citations. By reinforcing good performance, fleets encourage driver acceptance.

The use of on-board computers may be less attractive to fleets that already exercise close surveillance and control over their drivers and vehicles. For example, a fleet with standardized, recurrent routes and established travel time allocations for these routes would likely have less use for the information from on-board computers than would a fleet with highly variable routes. Chapter 5 of this report addresses these kinds of fleet management considerations in more detail.

**Legal Considerations**

Speed monitoring reports are admissible as evidence in courts. Reportedly, there have been circumstances where these reports have proven that a driver was not speeding at the time of an accident or was not otherwise at fault. In other situations, reports from recorders have been used to challenge and prevail over speeding citations, thus saving drivers' jobs.

Another legal issue to be considered is the possibility of driver self-incrimination. On-board computers may, of course, document speeding or possibly other unsafe driving practices. This raises the legal question of whether the computer constitutes improper surveillance equipment that threatens the driver with self incrimination should data recorded on the computer be confiscated and used as evidence against the driver. The use of a driver identification code may be challenged for the same reason.

### 4.3.2 Tachographs

Tachographs are mechanical devices designed to supplement standard speedometers and tachometers.

**Mechanism**

A variety of models, some of which are electronic, are available. Using pressure-sensitive, plastic-coated paper charts, and two mechanical styli, tachographs record vehicle speed and engine speed as a function of time. From these data, distance traveled, engine on/off periods, and instantaneous rpm can be computed.

**Operation**

Tachographs begin recording information when the tractor truck ignition is turned on; consequently, the driver is not directly involved in the operation of this device.

Recording charts, which are printed on one side, are available in two forms: round for 12- or 24-hour applications; and strips for extended time applications of 8, 15, or 3 1 days. A stylus makes a permanent recording of the vehicle operation on the printed side of the chart.

Tachographs, which have a clock, speedometer or tachometer, and odometer, are mounted on the dash for easy viewing by the driver. If the driver exceeds the preset speed limit, an overspeed light goes on to warn the driver, and the speeding is recorded on the chart.

**Market Penetration**

At their peak penetration in the early 198Os, more than 500,000 tachographs were in use. The majority of these were installed on combination-unit tractors. Thus, roughly one-fourth to one-third of the truck tractors in the United States were equipped with tachographs. However, these devices are currently not being used or purchased as often as they once were. Increased use of more sophisticated electronic devices, such as on-board computers, will greatly diminish the market for tachographs in the coming years.

**Cost**

Unit cost is $300-$500. In addition to the cost of the device itself, other expenses are incurred because the tachographs require regular maintenance, management staff must be specially trained to read the charts, and management time is required to review the charts.

**Tampering**

It is relatively easy to tamper with tachographs. For example, the styli may be bent or the clock may be advanced as a means of altering the chart. Such tampering, though, is easily noticed.

Tachographs have cross-referencing and back-up features built in to uncover reporting discrepancies.

They also feature independent stylus action, meaning that tampering with one stylus will not affect the recording of the other stylus. Some manufacturers sell an optional lock for the box that houses the chart making the device much more tamper resistant.

**Management Approaches** Manufacturers of tachographs recommend that positive incentive programs be implemented to reinforce speed compliance rules and reduce driver resistance to the devices, and that managers take action to discourage and/or punish driver tampering with the devices.

## 4.4 Engine Speed Governors

Engine speed governors are devices attached to the engine which limit the number of engine revolutions per minute (rpm). All diesel engines must have engine speed governors to prevent the engine from overspeeding. The limitation of maximum rpms, built into the engine to protect it, can also be used to limit maximum vehicle speed. However, governing vehicle speed through the use of an engine speed governor requires that the transmission ratios, rear axle ratios, and tire sizes all be carefully specified, since all of these factors influence the top speed of the vehicle. And, the speed-limiting effects ordinarily apply only to 65 mph highways, since a vehicle that is speed-governed at 65 mph could still, for example, travel at 60 mph in a 55 mph zone.

Conventional mechanical devices are described in Section 4.4.1. The new electronic engine speed controls, representing a superior technology for both engine efficiency and potential for vehicle speed limitation, are discussed in Section 4.4.2.

### 4.4.1 Mechanical Engine Speed Governors

Mechanical engine speed governors are devices attached to the engine which limit the number of engine revolutions per minute (rpm). Until the advent of electronic engine controls, all diesel engines were equipped with mechanical engine speed governors. In addition, some gasoline engines have been equipped with these devices.

**Mechanism** Engine speed'governors limit rpms to some maximum (e.g., 2100 rpms) through the use of high-speed and low-speed springs and weights. Rotational speed-induced centrifugal force, which is mechanically-generated in proportion to engine speed, causes the weights to act through a linkage system to retard the engine's throttle.

**Operation** Maximum rpms are based on engine specifications selected by the vehicle purchaser. Operation does not require any assistance from the driver.

**Governor "Overshoot"** Mechanical engine speed governors are set to limit engine speed under full load conditions; if they were set for less than full loads, the vehicle would not have the horsepower to travel at highway speeds when carrying a full load. However, a problem known as "governor overshoot" (also known as "droop") arises when the truck is hauling less than a full load. A partially-empty truck or one otherwise not putting a full load on the engine could have an engine speed (and therefore a road speed) in excess of the "governed" speed. The extra fuel that is available at less than maximum power output sends the engine above its nominally-rated rpm and allows the driver to attain higher speeds. The maximum engine speed (and thus road speed) increase possible from this "overshoot" is approximately 10 percent, so that a vehicle mechanically governed to have a maximum speed of 60 mph could travel as fast as 66 mph when empty.

**Market Penetration** As noted above, all diesel engines except those equipped with the new electronic controls are equipped with mechanical engine speed governors. The market for mechanical engine speed governors will decline as the new electronically-controlled engines become predominant.

Presently some retrofit devices are sold for heavy duty gasoline engines, but this is a very small market.

**Cost** Not a separate cost item when part of original engine. Retrofit governors cost $350-$1500 per unit.

**Tampering** Mechanical engine speed governors can be altered by a knowledgeable driver or mechanic. Detection requires a mechanical inspection of the engine or "revving" the engine to determine maximum rpms from the tachometer. Tampering with an engine speed governor, if detected, may result in the voiding of the manufacturer's warranty on the engine.

### 4.4.2 Electronic Engine Speed Controls

The Environmental Protection Agency's heavy duty engine emission control regulations require more stringent emissions standards in the 1991 model year, with further emissions reductions required beginning with the 1994 model year. New truck diesel engines developed to meet the 1991 standards, and under development to meet the 1994 standards, include electronic governors to control engine speed. In model year 1991, electronic engine controls are optional, but by 1994 they will likely be standard equipment. These electronic controls are intended primarily to ensure that emissions standards are met, but they have the ancillary benefits of improving fuel economy and providing a means of limiting maximum vehicle speed. However, as was noted earlier, these controls do not limit downhill roll speed. This approach to limiting truck speed is described below:

**Mechanism** Electronic controls modulate and limit engine rpms and engine fueling, based on inputs from engine- and vehicle-mounted sensors (e.g., road speed sensors) and on inputs from the driver. They can be programmed to meet fleet management speed specifications. Since they sense both vehicle and engine speed (and modulate rpms accordingly), they eliminate the problem of "governor overshoot."

**Operation** Operation of trucks with the new electronically-controlled engines is virtually identical to the operation of trucks with conventional engines.

The new engine systems also provide a built-in cruise control which, if tampered with, will become inoperable. The cruise control functions by using the miles per hour sensor to compare the actual road speed of the truck to a preset or programmed speed. Depending on the speed of the truck, the amount of fuel is automatically increased or decreased. If the driver tries to override the cruise control (e.g., by setting a very high speed), the truck engine defaults to the originally programmed number of RPMs, thereby limiting speed.

The transmission and rear-axle gear ratios on vehicles with the new engines are set to provide maximum fuel economy at the most efficient engine rpm and desired vehicle cruising speed. This customizing reinforces the fuel economy and speed limitation benefits of the engine, and does not create the compromise of economy found with straight gear binding. Industry sources indicate that most electronically-controlled engines have purchase specifications (selected by the buyer) for optimal cruising speeds in the 55 mph to 65 mph range.

**Governor "Overshoot"** Electronically-controlled engines do ***not*** have the "governor overshoot" problem characteristic of mechanically-controlled engines since they sense both engine and vehicle speed.

**Market Penetration** Sales of new combination-unit tractors are expected to average 125,000 to 175,000 units annually over the next decade, depending on economic conditions. Approximately 75,000 to 100,000 old, nonequipped units will be discarded each year. Currently, there are about 1.5 million registered tractors. Thus, the market penetration of the electronically-controlled engines will increase by approximately 7-10 percent annually until fleet turnover is nearly complete in the early 2000s. Although the penetration of the new engines will be nearly complete by the early 2000s, the degree of speed limitation will depend on the speed-limiting specifications selected by the purchasers of the trucks.

Market penetration of the electronically-controlled engines into the large single-unit truck fleet is expected to proceed in a parallel fashion to that described above over the coming two decades.

**Cost** The costs associated with the speed-limiting features of the new electronically-controlled engines are very small, since this capability is built into the design of the engines for other reasons.

**Tampering** The electronic microchips controlling engine speed can be modified to change the limits on engine maximum RPM. However, if tampering occurs, these systems are designed to be self-defeating. Thus, only highly-skilled electronics/computer technicians would likely be capable of modifying these devices.

**Management Approaches** When fleet managers order new combination-unit trucks, they specify the maximum speed requirements of the vehicle. Optimal engine rpms, transmission ratios, rear axle ratios, and tire sizes are specified and customized to fleet requirements. This means that the engine will have optimal efficiency under the operational conditions specified by the purchaser (i.e., load weight, terrain, cruising speed). If desired, electronic controls can be programmed into the engine to ensure that the vehicle does not travel at speeds greater than the desired top speed. This technological capability greatly enhances management's power to control the top cruising speeds of its fleet vehicles.

## 4.5 Vehicle Road Speed-Limiting Devices

The term "road speed-limiting devices" refers to mechanisms attached to the engine or transmission that limit the maximum engine-controlled speed at which a truck may operate. As noted earlier, these devices do not control downhill speed.

The devices fall into two categories: vehicle-controlled and driver-controlled. Vehicle-controlled speed control devices are known as road speed governors. Driver-controlled speed control devices are commonly termed cruise controls.

### 4.5.1 Vehicle-Controlled Devices (Road Speed Governors)

Road speed governors are add-on devices which use direct and continuous road speed sensor measurements to limit speed. Addressed here are conventional road speed governors that might be retrofitted on a diesel engine not already equipped with electronic engine controls. The road speed governoring element of the new electronic engine speed controls were addressed in Section 4.4.2.

**Mechanism** Main components include a speed sensor, signal processor, and control actuator. Speed sensors and signal processors may be electromechanical or electronic. The speed sensor sends a signal **to** the signal processor, which in turn actuates a control mechanism on the throttle. When cruise controls are used with road speed governors, they operate on a signal transmitted by the speed sensor.

**Operation** Since road speed governors are controlled by devices attached to the engine and peripheral sensors, the driver is not involved in the operation of this device.

**Market Penetration** Of the approximately 1.5 million truck tractors in the United States, about 10 thousand (less than 1 percent) are equipped with conventional road speed governors.

**Cost** Unit cost is $190-$1500 (higher cost is for refit governors).

**Tampering** Road speed governors may be easily disabled or bypassed by a driver or mechanic.

### 4.5.2 Driver-Controlled Devices (Cruise Controls)

Cruise controls are devices that maintain a precise driver-selected vehicle cruising speed on highways. Conventional cruise controls are add-on devices; newer ones are built into electronically-controlled engines as a part of the limiting features of the engine. For use in the trucking industry, they usually are installed with a preset maximum as a method of limiting top cruising speed. The driver can select, for his/her own convenience, a cruising speed within the predetermined range. The preset maximum cruising speed limits the vehicle's maximum speed whenever the cruise control feature is activated.

**Mechanism** Cruise control devices regulate truck speed by an electronic fuel pump actuator. If the driver exceeds the preset maximum, the actuator automatically adjusts the throttle and reduces the speed.

**Operation** Foot-off systems allow drivers to attain the desired road speed, set the speed, and then remove their foot from the throttle. The unit disengages when the brake or clutch pedal is pressed.

**Cost** Unit cost is $175-$400.

**Tampering** Cruise controls are not tamper proof; their connecting wires can be cut. However, there is little incentive for this form of tampering and it is easy to detect.

## 4.6 Vendor Studies

None of the manufacturers interviewed had conducted any observational fleet studies regarding the use of their devices and speed related issues.

## 4.7 Summary and Conclusions

There are a variety of speed-monitoring and speed-limiting devices available to fleet operators in the trucking industry. Some devices, such as the tachograph, are older, somewhat limited instruments which, though still available in the industry, are gradually being replaced by newer, more sophisticated equipment (both speed-monitoring and speed-limiting). Manufacturers are continually updating and improving their speed control and monitoring devices to meet fleet demands for improved economy and efficiency.

Based on the discussions with manufacturers, the following general conclusions may be drawn:

- Overall, the use of speed control equipment is increasing except for older mechanical devices such as mechanical road speed governors and tachographs.

- Most speed control devices, including electronically-controlled engines, are tamper resistant, and/or tampering can be detected. However, none is truly tamper proof.

- On-board computers have the capability of providing a continuous record of vehicle speed and other vehicle performance measures. These devices offer an economically-attractive means of monitoring vehicle speed. However, their usefulness varies greatly depending on fleet route patterns and other factors, and there are legal considerations relating to their use.

- Manufacturers emphasize that management involvement through company policies, incentive programs, and disciplinary action is critical to the successful implementation of speed limiting devices.

- Within a decade, the great majority of truck tractors in operation will be equipped with electronically-controlled engines. These engines have been introduced primarily to reduce emissions and improve fuel economy. The transmission and rear-axle gear ratios on vehicles with the new engines are set to provide maximum fuel economy at the most efficient engine rpm and desired vehicle cruising speed. Industry sources indicate that most electronically-controlled engines are specified by purchasers for typical cruising speeds in the 55 mph to 65 mph range. They can also be preset to limit maximum highway cruising speeds at a set point specified by the buyer. This gives fleet managers an effective means to limit the maximum speeds of their vehicles on the roadway. However, the speed-limiting components of these engines can be reprogrammed or defeated by a skilled person. This underlines the need for active management support of any fleet program to limit maximum highway speeds of fleet vehicles.

## 5.0 FLEET APPLICATIONS OF SPEED CONTROL DEVICES

This chapter presents information about fleet use of speed control devices (speed-limiting and speed-monitoring) based on discussions/interviews with five truck fleet managers, and other individuals knowledgeable about trucking operations. The emphasis was on fleets with a strong management motivation to minimize speeding and which make some use of devices intended to monitor/control truck speed.

### 5.1 Study Method

Five major fleets, each having 100 or more tractors, were contacted. Four of the five were selected from a list of names provided by the manufacturers of speed control devices. A fifth fleet known not to use physical speed control devices was identified through industry sources and included to provide an alternative perspective on the use of such devices. Fleet managers were contacted by telephone. The sample selection was intended primarily to reveal the experiences of fleets employing speed control devices, and is not statistically representative of the entire trucking industry. The study attempted to find out the types of devices fleet operators use, general driver reactions to these devices, tampering problems encountered and consequences, kinds of incentive programs offered, and general level of fleet satisfaction with the devices they are using.

Another objective of the study was to discover whether any of the fleets had conducted systematic studies that examined the use of a speed control device with respect to speeding and number of accidents and, if so, what the findings indicated.

Representatives of the following fleets were interviewed:

- Consolidated Freight Company, Menlo Park, California
- Martin-Brower Company, Des Plains, Illinois
- Midwest Motor Express, Bismark, North Dakota
- Transcorp Carrier, Greensboro, North Carolina
- Wetterau Transportation, Inc., Hazelwood, Missouri.

NHTSA greatly appreciates the information provided by the above fleets regarding their management practices. However, since this study was not intended to report on the management practices of specific fleets, the remainder of this chapter does not identity which of the above fleets employ which specific management practices.

## 5.2 Fleet Approaches to Speed Monitoring/Control

All five of the fleets contacted indicated that their management is strongly motivated to minimize speeding and is interested in identifying effective technological and management approaches to achieving speed control.

Four of the five fleets use on-board computer monitoring devices and/or add-on speed-limiting devices (road speed governors or cruise controls). The two maximum speed settings reported for speed control devices were 65 mph and 58 mph. The fleets selected these speeds because they wanted to prevent their drivers from exceeding a 65 mph cruising speed. The lower, 58 mph setting may allow for "governor overshoot" in keeping the truck under 65 mph (see Section 4.4.1 for an explanation of "governor overshoot"). Monitoring devices are also used by fleets to obtain information such as the following: trip time, idle time, amount of shifting and braking, travel speed, fuel usage, and number of stops.

The amount of experience managers had with the devices ranged from three to nine years. Managers generally felt that speed control devices were more effective and required less management time than speed monitoring devices.

As noted earlier, one fleet was included in the interview sample because it was known *not* to use physical devices to limit truck speed (other than the engine speed governors built into all diesel engines). The management of this fleet controls truck speed through a combination of monitoring of travel times between fleet terminals, direct surveillance of trucks by company "highway patrols," monitoring of maintenance costs (which may reflect driving practices), and individual/group incentives for safe driving. The management of this fleet felt that these other measures precluded the need for special devices to monitor or control vehicle speed.

## 5.3 Driver Acceptance and Device Tampering

Overall, fleet managers felt that the majority of their drivers accepted speed control devices, although they reported that some drivers disliked the devices and felt threatened by them. One fleet manager reported a purposeful practice of hiring drivers who did not object to the use of such devices.

Tampering was not considered a major problem, in part because there were no strong economic incentives for drivers in most of these fleets to tamper with the devices. However, tampering did occur periodically. The managers discussed a variety of management responses to tampering. This included consequences such as verbal warnings, recording the event in the driver's performance record, fines, other penalties, or even termination.

## 5.4 Incentive Programs

The fleet managers contacted use a variety of positive and negative incentives for minimizing speeding among their drivers. One manager calculates fleet savings resulting from speed limit compliance and adds a portion of the savings to drivers' paychecks. Another manager described a company safety program that offered driver awards based on accident-free driving and gave drivers an opportunity to participate in state and national driving competitions.

In addition to these positive methods of obtaining driver speed compliance, most fleets also used disincentives/penalties for noncompliance. These included fines, suspensions, termination, and providing bad references.

None of the fleets contacted use the kind of systematic reward-incentive behavioral programs envisioned by device manufacturers (see Chapter 4) or by industrial safety specialists. Such systematic reward-incentive programs might employ a variety of behavior change techniques to ensure effective results from the use of devices such as speed monitors. For example, Geller (1990) defined 24 interrelated techniques to motivate behavior change. The following techniques described by Geller (here redefined in the context of truck speed control) are particularly relevant to the effective application of speed control devices in fleet settings:

- **Stated Policies** - established written fleet standards, norms, or rules for speed compliance.

- **Announced Goals** - Company determines (perhaps in consultation with drivers) desired level of speed compliance (e.g., miles traveled without indications of speeding).

- **Feedback** - Management provides periodic information to drivers regarding fleet speed compliance performance.

- **Incentives/Rewards** - Management presents a desirable item (e.g., a bonus) to drivers if their speed compliance meets goal.

- **Disincentives/Penalties -** Management warns, reprimands, or penalizes drivers for speeding, or withdraws bonus or other desirable item, if speed compliance does not meet goal (e.g., if there are too many miles traveled at excessive speeds).

The above behavioral management techniques are interrelated and might all be applied simultaneously. Geller and other behavioral psychologists specializing in industrial safety generally emphasize the use of ***positive*** incentives (e.g., rewards contingent on desired speed compliance) as opposed to the use of negative incentives (e.g., penalties contingent on excessive speeding citations). The use of negative incentives is much more likely to result in undesirable side effects such as driver hostility toward management, tampering with devices, falsification of data, or other efforts to "beat the system" (Geller, Lehman, and Kalsher, 1989).

Ironically, perhaps, the fleet from the current study sample that uses the most systematic approach to behavioral control is the fleet that does *not* employ add-on speed control devices. In this fleet, individual drivers and groups (e.g., drivers based at a particular terminal) receive announced awards and gifts based on length of accident-free driving time. Note, however, that rewards are contingent not on a particular behavior (e.g., speed compliance) but rather on an outcome (i.e., accidents). Behavioral psychologists such as Geller (1990) argue that contingency management is more effective if based on particular driver behaviors (e.g., average travel speed).

## *5.5* Fleet Satisfaction

Overall, the fleets in the study sample that use speed control devices are satisfied with them. The primary reasons fleets initially purchased their equipment was not to improve safety but rather to improve fuel economy and extend engine life. A side benefit has been reduced potential for crashes. Generally, the fleet managers contacted like the control that road speed governors and cruise control systems offer them as well as the individual tailoring to fleet needs that monitoring systems provide.

All of the managers using speed control devices felt that using them had reduced the travel speeds of the vehicles in their fleets. One manager reported that none of his drivers had received any speeding tickets in more than three years. All managers of fleets using speed control devices said that they would continue to use them in the future.

## 5.6 Fleet Studies

None of the fleets contacted that use speed control devices had conducted any systematic studies to determine whether use of the devices had been associated with a reduction of average vehicle speed, speeding citations, or accidents. One fleet manager stated that his fleet's crash rate had dropped during the three years that control devices had been used. However, no fleet records were available to validate this claim.

## 5.7 Conclusions Regarding Fleet Applications

Within the context of the small number of fleets contacted for the fleet applications part of this study, the following general conclusions can be drawn:

- Most of the fleets contacted use a combination of speed-limiting and speed-monitoring devices, and are satisfied with the results obtained.

- A majority of the drivers accept the devices. Tampering, although it occurs periodically, is not a critical problem, at least in this sample of fleets where management was motivated to prevent tampering and control fleet vehicle speed.

- Most fleets contacted use incentives--positive and/or negative--to encourage speed compliance. However, most incentive programs are not highly systematic. The programs tend to emphasize negative incentives and/or rewards based on outcomes (i.e., crashes). A more effective approach might be to emphasize positive incentives and rewards based on ***driving behavior*** that can be readily monitored. Examples of such behavioral measures include average travel speed per trip and percent of time under an established fleet speed limit. Safety specialists recommend systematic incentive programs involving announced fleet policies and goals, feedback to drivers, and positive rewards/incentives contingent on driver behavior (e.g., adherence to company speed policy).

- One contacted fleet, characterized by established, recurrent routes, considered the use of speed control ***devices*** to be unnecessary. This fleet maintained that vehicle travel speeds could be controlled through management techniques such as keeping records of terminal departure and arrival times, with appropriate follow-up management action contingent on driver behavior. The experience of this fleet illustrates that "speed control" does not necessarily require the use of devices on vehicles. The attractiveness of devices for speed control is probably inversely related to the degree of standardization of routes possible within a fleet. In a fleet where routes are generally invariate and standardized, management may feel little incentive to invest in vehicle devices to control vehicle travel speed.

## 6.0 CONCLUSIONS AND RECOMMENDATIONS

This report has addressed the extent of truck speeding, especially speeding at high speeds, and its significance as a contributing factor in truck crashes. Devices for either limiting or monitoring/recording truck speed have been described and recommendations offered as to how best to address the issue of speed-related crashes. Of particular note are the following points:

- A significant proportion of combination-unit trucks operating on Interstate highways travel at speeds in excess of 65 mph. The extent of truck speeding varies, however, depending on whether the posted speed limit is 55 or 65 mph. On roads posted at 55 mph, 5-20 percent of trucks speed in excess of 65 mph, whereas on roads posted at 65 mph, 40-50 percent of trucks exceed that limit. By comparison, 15-30 percent of all passenger vehicles (cars and light trucks) exceed 65 mph on roads posted at 55 mph, while 50-70 percent exceed 65 mph on roads posted at that limit. When trucks do speed, it is typically at levels just over the speed limit. The incidence of trucks traveling at very high speeds (e.g., greater than 10 mph above the speed limit) is low in comparison to passenger vehicles.

- Although trucks are most visible to the public on Interstates and other high-speed highways, most heavy truck crashes do not occur on roadways where very high travel speeds are prevalent. More than 90 percent of combination-unit truck crashes and 95 percent of single-unit truck crashes occur on roadways where the speed limit is less than 65 mph, and where the incidence of very high speeds (e.g., >70 mph) is low. Speed-limiting devices would have no effect on vehicle speed or crash likelihood at travel speeds below their set point.

- Police Accident Report (PAR) data may understate the involvement of speeding in crashes for all vehicle types. However, the presumption has been made here that these data permit valid comparisons among vehicle types in terms of the involvement of speeding in their crashes. Moreover, the categorization "speeding-related" or "high-speed related' does not necessarily assure that speeding ***was*** the ***primary cause*** of the crash. Most crashes involve multiple contributing factors. The elimination of any one factor--e.g., high speed--may or may not prevent the crash. Thus, the speeding-related and high-speed-related crashes identified in this report should not be viewed as the number of crashes that would be prevented by speed limitation.

- By all measures, the speed-related and speed > 65 mph-related crash involvement of ***single-unit*** heavy trucks is very low compared to other vehicle types.

- Comparatively few combination-unit truck crashes involve truck travel speeds in excess of 65 mph or 70 mph. For example, there are an estimated 30 combination-unit truck speeding > 70 mph-related non-grade fatal crash involvements per year, representing less than 1 percent of the total fatal crash involvements of combination-unit trucks (at all travel speeds), and less than 1 percent of speeding> 70 mph-related crash involvements of all vehicle types combined. Thus, the target crash problem size for speed-limiting devices is relatively small.

- Combination-unit truck involvement *rates* (per million VMT) in speeding-related crashes are much lower than those of passenger vehicles. For example, the combination-unit truck involvement rate in relevant speeding > 65 mph crashes is about 1.0 per 100 million VMT, versus a rate of 4.6 per 100 million VMT for passenger vehicles.

- ***The likelihood*** that a given truck will be involved in a speeding-related crash is greater than that of passenger vehicles for speeding (TS > PSL) and speeding> 65 mph crashes, and similar to that of passenger vehicles for speeding>70 mph crashes. Trucks travel, on average, six times as many miles per year as do passenger vehicles and travel a greater proportion of their miles on 65 mph rural Interstate highways. Therefore, their exposure to crash risk, particularly crashes on 65 mph highways, is greater than other vehicles.

- Speed-limiting devices include mechanical engine speed governors, cruise controls, road speed governors, and electronically-controlled engines with transmission/rear axle/tire ratios designed to physically limit vehicle speed. All these approaches have limitations. First, as noted, none of these devices effectively control downhill vehicle speeds. Mechanical engine speed governors limit the engine's maximum speed, but do not limit the vehicle's top speed unless the engine is matched with a transmission and rear axle geared to also limit top speed. Even then, conventional engine speed governors allow the engine to "overshoot" and thus attain higher than rated vehicle speeds. Cruise controls must be activated by drivers and, therefore, can be set at speeds higher than 65 mph or simply not be activated. Road speed governors, devices that monitor and control actual vehicle speed, can effectively limit truck speed. However, most designs are only tamper-resistant rather than tamper proof.

- Speed monitoring/recording can be accomplished with a variety of electronic and mechanical devices and can be an effective tool for fleet managers to use in their efforts to improve both the speed limit compliance and fuel efficiency of their vehicles. The use of speed monitors may improve speed compliance on both 65 mph and 55 mph highways, if fleet managers know the speed limits of the roadways traveled by their vehicles. However, monitors do not directly limit speed, and their effectiveness depends on active and continuous involvement of fleet management.

- Two current trends in particular--the development and market penetration of electronic engine controls and the establishment of the Commercial Driver's License Program--are expected to mitigate against truck speeding in the coming years. Most new electronically-controlled engines purchased today have buyer-selected specifications that optimize their performance in the 55-65 mph cruising range. This increases the economic incentives to maintain legal speeds. The CDL program targets flagrant and/or repeat speeding offenders, the same operators who would be most likely to defeat or circumvent mandatory speed-limiting devices.

- Having reviewed all these factors, the agency concludes that there does not appear to be justification at this time to consider requiring all heavy trucks to be equipped with speed limiting devices. Problem size statistics suggest that the number of target crashes is low, especially when viewed against the overall truck crash picture or against the overall problem of highway speeding. Speed-limiting devices would not dramatically change the distribution of truck speeds on the highways, since most trucks now travel at speeds below levels likely to be set by the devices, and those that are currently traveling at higher speeds are typically traveling at speeds just a few miles per hour higher. It is not certain whether the marginal reduction of speed for these vehicles would actually reduce their crash risk (or resulting fatality risk) significantly, since other, nonspeed-related driver errors may still occur and cause similar crashes and injuries. For all of these reasons, the incremental benefits of mandatory speed limitation in terms of either crash reduction or lives saved are questionable.

- Although the number of high-speed-related heavy truck crashes appears to be small, this report has highlighted the fact that voluntary compliance with posted speed limits on rural Interstate highways by both heavy truck and passenger vehicle operators is poor. Highway speeding appears to be a widespread highway safety concern that is not limited to commercial motor vehicles. Public information and education programs, coupled with increased speed enforcement (for all vehicle types) may be the best method of achieving improved highway speed limit compliance.

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